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THE AMERICAN GAS LIGHT JOURNAL

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Twenty-Second Annual Meeting, American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION,
OFFICE OF SECRETARY, PROVIDENCE, R. I., Oct. 5, 1894.

Extract from the Constitution.

Sec. 12. Application for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least 10 days prior to the meeting at which the application is acted on.

GENERAL ANNOUNCEMENT.

The 22d annual meeting of the American Gas Light Association will be held at Washington, D. C., October 17, 18 and 19, 1894.

The meeting will be called to order by the President, W. H. Pearson, of Toronto, Canada, at 10 o'clock, A.M., on October 17, in Builders' Exchange Hall, on 13th street, between G and H streets. This is 3½ blocks from the headquarters, the Arlington Hotel, which is located on the corner of H street and Vermont avenue, one block from the White House. The Arlington is conveniently reached by the principal street car lines, as are the other first-class hotels in its vicinity.

As the most satisfactory quarters are always obtained by writing in advance to the hotel people, the following list of hotels is appended, and it is particularly suggested that in writing to them a reply be requested, for which a self-addressed and stamped envelope should be inclosed, as misunderstandings and disappointments may thereby be averted. Remember, "First come, first served."

Hotel.	Rate per Day.	Distance from Hall.	Remarks.
Arlington.....	$4 to $5	3½ blocks.	This is headquarters.
Riggs House....	$3 to $5	2 "	Located at 15th and G streets.
Willard's	$3.50 to $4.50	3½ "	Located at 14th street and Penn ave.
Ebbitt House...	$4	2½ "	Located at 14th and F streets.
Wormley's.....	$3	2½ "	Located at 15th and H streets.
Normandie.....	1 in room, $4.50 2 " 3.50 3 " 3.00	4 "	Located at 15th and I streets. Can take 100 persons.
Shoreham.....	$4	2½ "	Located at 15th and H streets. Can take 125 to 150.
Hamilton House	$2.50 up	4 "	Located at 14th and K streets.
National.....	$4	10 "	Located at Penna. av. and 6th st. Cars go within 3 blocks of hall.
Metropolitan....	$2.50	10 "	Penna. ave., close to National Hotel.
Howard House.	$2.50	10 "	Penna. ave., close to National Hotel.

All of the above hotels are conducted on the American plan, and can take from 25 to 50, except the Normandie and Shoreham (see "Remarks," above). The rates named by the Arlington, Riggs, Willard's and Normandie are special for this convention.

The Ebbitt has also made reductions, viz.: Fifty rooms on 6th floor, with steam heat, reduced to $2.50 and $3.00 each person per day; fifty rooms on other floors reduced from $4.00 to $3.50. Nearly all other grades of rooms are also cut in price, so that those who wish more elaborate accommodations can obtain them at lower prices than formerly.

The roll call will be made by means of the door card method as usual, and be in charge of one of the Committee of Arrangements. Each member or visitor upon entering the hall for the first time will at the door receive a special card upon which to write his name, address, etc., the card then to be given to the doorkeeper.

The list of papers to be read at the meeting is as follows:

1. "Observations on Sundry Methods of Making Water Gas from Bituminous Coal" (Vol. XI., No. 1, page 58), with "Supplement" (Vol. XI., No. 2, page 169), by Frederic Egner.
2. "Public Ownership of Gas Properties" (Vol. XI., No. 1, page 67), by Walton Clark.
3. "A Small Experimental Plant as an Aid to the Management of a Coal Gas Works" (Vol. XI., No. 2, page 118), by Peter Young.
4. "Some Experiences with the Welsbach Incandescent Gas Lamp" (Vol. XI., No. 2, page 121), by W. S. Rathell.
5. "One of the First Meter Makers in the United States" (Vol. XI., No. 2, page 130), by H. C. Slaney.

6. "Light Wasted in Bad Flames" (Vol. XI., No. 2, page 146), by N. W. Gifford.

7. "Applications of Chemical Technology to Gas Manufacture" (Vol. XI., No. 2, page 149), by Geo. H. Harper.

8. The Use of Gas for Other Purposes than Lighting" (Vol. XI., No. 2, page 172), by Burdett Loomis.

9. "Taxation" (Vol. XI., No. 2, page 181), by Allen R. Foote (by request).

10. "Patching Holders while in Use" (Vol. XI., No. 2, page 194), by J. H. Findlay.

Also two or three others that have not yet been turned in to the Secretary.

The members are particularly requested to carefully read every page of the July and October "Quarterlies," and come to the meeting prepared to discuss the articles therein presented, as the papers will be distributed in that form only.

Each member is expected to send in not only papers on original subjects, but also written discussions or analyses of any or all of the papers written by others, such written discussions to appear in the next issue of the "Quarterly."

The Question Box will be be made a special department of the "Quarterly," provided the members will support it by sending in responses to queries, as well as to keep the Box full of questions, which will be printed in each issue with the responses to the queries of the previous issue. Send in your questions as early as possible; *now*, if you can. Questions sent in for this meeting will be found in Vol. XI., No. 2, page 196.

Application Blanks will be found among the last pages of the April and October Quarterlies.

The Committee of Arrangements are completing the details of their programme, which is expected to include the usual banquet, an excursion to Mt. Vernon, etc., and the members and their ladies have been invited to visit the Maryland Meter and Manufacturing Co., of Baltimore, on Saturday, 20th, by whom they will be hospitably received. During the meeting the comfort and amusement of the ladies will also be attended to, for full details of which consult the programme which you will receive at the meeting.

Agreeably to the ancient custom of the Association, it is proposed to hold the traditional banquet on the evening of Thursday, Oct. 18, and in continuation of the precedent established last year, each one will pay for his own ticket. Price of banquet ticket has been fixed at $5.

Have you returned to the Secretary the card sent with the circular of September 10th? This is very important, that the data therein asked for should be in his hands as soon as possible, ***whether you expect to attend the meeting or not.*** The Committee cannot complete their work without it.

During the days of the meeting bulletin boards will be placed in the lobbies of the Headquarters and the Meeting Hall. All members are warned to take due notice thereof and govern themselves accordingly, that they may be apprised of any change in or addition to the programme.

Many of the members have allowed their dues to remain yet unpaid, and this is a source of much difficulty to the Treasurer and extra work and worriment to the Secretary, who has already sent several statements to each of the delinquent ones, as you must know, if you are one of them, unless you have failed to notify him of change of address.

The present addresses of the following-named members are unknown to the Secretary, who will be glad to receive any information concerning them: E. H. B. Twining, W. I Wilson, L. S. Jones and Frank Bierce.

Special Cars, etc.—The Secretary's party will go via Fall River Line on Monday evening, and join the New York party on the 11:30 A.M. Royal Blue Line train Tuesday forenoon. The party from New York will be a large one, and several special cars have been secured, affording ample and first class accommodations. If you are not booked for the party of the Secretary of the N. E. Association, by all means join this party, as a special agent of railroad companies is to accompany us to insure every comfort.

A. B. SLATER, Jr., Sec.

Extract from the Constitution.

51. No member who owes two years' dues shall be entitled to vote, or to participate in the deliberations of the Association, or to receive a copy of the Proceedings.

52. Any member whose dues shall remain unpaid for a term of three years may be dropped from the roll of membership by a vote of the Council.

BRIEFLY TOLD.

THIS WEEK AT WASHINGTON.—Just before going to press with our last issue we received Secretary Slater's final official circular respecting the American Association's meeting, and although it came to hand too late to permit us to make appropriate comment on its lines, it was nevertheless our good fortune to be able to print its main points—in fact, the only portion which we were forced to omit was that which referred to the manner of securing the rebate from the regular fares allowed by the railroads to those who will attend the convention. Nor was this an unfortunate omission, for the station agents at the different points in the States—nearly every delegate and visitor to the meeting will travel by a road which agrees to make the concessions—will tell the inquirer how to proceed in the premises. As will be seen from the Secretary's enumeration, the paper list promises 10 papers, on a wide range of subjects, that have already been printed in the Association Quarterly (Vol. XI., Nos. 1 and 2), and the further expectation is that two (possibly three) others are to be presented. The President's address is to be added to the foregoing, wherefore there will be no dearth of subjects for discussion, especially when it is remembered that the Question Box already contains much meat for digesting. According to our former predictions, all of which are now certain of realization, the convention will be important, instructive and pleasing; and in point of attendance it bids fair to make a record. Referring to the invitation extended by the proprietors of the Maryland Meter and Manufacturing Company, of Baltimore, to those in attendance to visit the Company's new factories, on Saturday, 20th inst., we have it from the Company that in all probability a special train will be chartered for the perfect convenience and comfort of its guests. This train will leave Washington at 9:30 A.M. of Saturday, arriving at Baltimore 50 minutes later.

A PROVISION OF THE PROPOSED NEW CONSTITUTION FOR THE STATE OF NEW YORK.—Most residents of New York have been aware, in a general way, that a body known as a Constitutional Convention has for some months past been deliberating for the purpose of giving to New York a new Constitution, and the general public also knows, however vaguely, that the Constitution has been agreed upon, and that its tenets, regulations and restrictions are to be submitted to the public at the election in November, for their approval or rejection. Looking over the official document submitted as the report of its labors, one could easily find ground for surprise in that New York's present Constitution was so badly in need of rehabilitation, or of the application of such varied and drastic measures to make it take on real soundness. Indeed, we think the voters will hold to the belief that the doctors were not only too many, but were too much on the specialist order. Every whim and fad seems to have had an advocate, and all seem to have secured more or less recognition, judging from the wonderful *melange* of orders respecting what may be done and what shall not be done hereafter in the State. However, the provision to which we wish to call attention at this time is contained in Article III., sec. 18, lines 21 and 22, where it is laid down that hereafter the Legislature shall not pass a bill "granting to any private corporation, association or individual any exclusive privilege, immunity or franchise whatever." Now we submit that this is not in line with progress of the substantial sort, for it will act as a bar to the development of many of the smaller centers of population in New York; and if not to their development in point of numbers, it will so act in depriving the people of such places of some of the prime conveniences of life for a greater period than would be the case did such restriction not exist. Good supplies of water and light in fact are now regarded as necessities, not conveniences, and there is no gainsaying the assertion that many places in the State would now be without either had they to depend on the willingness of the local rulers to tax the inhabitants directly for the initial capital needed to establish the works. Private capital has always been in advance of money raised by taxation to take the risk of maintaining water and lighting plants in the smaller places (say in places of 5,000 souls), and it is not asking too much from the State that it shall guarantee exclusive privileges to the venturesome capitalist, for a fair term. The Supreme Court of the United States has, on more than one occasion, laid down the law that the principle of exclusive occupation of certain fields in industry, where such industry caters directly to the public need and welfare, is sound; and while we know that New York can plan out its own fundamental law, we are not so certain that it is just when it assumes to deny the right which the highest authority affirms. To our unconstitutional mind the action of the Convention in this respect seems nearsighted.

NOTES.—During the tremendous storm of wind and rain which swept the Eastern Coast of New York on the 10th inst., serious damage was done to the monster holder in process of erection for the New York and East River Gas Company. This holder (its calculated capacity is 5,000,000 cubic feet, which would make it the largest in America) stands in a peculiarly exposed position, on the western shore of Long Island, at a point known as Ravenswood, the opposite line in New York city being, say, 72d street, and it was in such a stage of construction as to make the guide framing peculiarly susceptible to the action of a violent, intermittent gale. The loss is considerable, but the builders (Messrs. R. D. Wood & Co.), with commendable pluck and promptitude, were at work on its repair before sundown of the day that it was damaged.—— We are informed that the Massachusetts Board of Gas and Electric Light Commissioners, as the result of their deliberations over the testimony submitted at the hearings of petitioners for a readjustment of gas rates at Worcester, have recommended the Worcester Gas Light Company to reduce the price to $1.25 per 1,000, a concession of 15 cents.

The History and Development of the Gas Engine.

Mr. W. Norris, M.I.M.E., in a lecture before the Lincoln (England) Schools of Science and Art, remarked:

The earliest attempts to obtain motive power from heat were made by igniting inflammable powder and utilizing the force of the explosion thus generated. As a source of energy, this combustible powder was the first agent used; it preceded the production of coal gas or steam. Strictly speaking, cannons are the oldest heat motors; and the principles on which they are constructed are identical with those of internal combustion engines. Heat is applied to explosive powder, and the expansion of the powder furnishes the motive force to propel the ball forward. In modern heat engines, a piston takes the place of the ball. In the early days of mechanical science, the energy shown in the projection of a cannon ball seemed to afford a simple solution of the problem how to obtain power and motion by heat. But the power produced by exploding powder in a cannon could not be used for practical work, because it was not generated continuously and regularly. To apply the expansive force of the gas given off during combustion, the combustible was exploded in a closed vessel and made to act upon a piston. These early combustion engines were the forerunners of modern gas motors, in which the power is also obtained by explosion. But though they were introduced nearly a hundred years before the first steam engine, they were soon abandoned, because it was found impossible to control the power generated. Steam was easier and safer to work with; and for more than a century explosive engines were wholly relinquished. The first to propose the use of explosive powder to obtain power was the Abbé Hautefeuille, the son of a baker of Orleans. To him belongs the honor of designing, not only the first engine worthy of the name, but the first machine using heat as a motive force. In 1678 he suggested the construction of a powder motor to raise water. The powder was burnt in a vessel communicating with a reservoir of water, and as the gases cooled after combustion, a partial vacuum was formed, and the water was raised by atmospheric pressure from the reservoir. Another machine, described by him in 1682, was based upon the principle of the circulation of blood, produced by the alternate expansion and contraction of the heart. Here the water was raised by the direct expansive action of the combustible gases given off by the powder when ignited. This was the first instance of a direct acting engine. Huyghens and Papin made several attempts to overcome the difficulty, but abandoned the use of explosive powder, and devoted their attention to steam.

For more than a hundred years after these early attempts, all efforts of scientific men and inventors were directed to the study of steam and its application to produce power. For the time, there was no other known agent that could compete with it. Gas extracted from coal had not yet been applied as a motive force in engines; and experience had shown that explosive powders were too dangerous and too intermittent in their action to be used with safety. The first to design and construct an actual gas engine was John Barber, who took out a patent in 1791. Various circumstances contributed to the success of his invention. The steam engine already occupied an important place in mechanical science, thanks to the genius of Watt, Newcomen, Smeaton and others. Workmen had by this time been trained able to turn out and adjust, with fair precision, the different parts of an engine, though good tools were still hardly to be obtained. The distillation of gas from coal had already been discovered by Dr. Watson, though it was not till 1792 that Murdoch applied it to practical use. Barber made the gas required for his engine from wood, coal, oil or other substances, heated in a retort, from whence the gases obtained were conveyed into a receiver, and cooled. A pump next forced them mixed in proper proportion with atmospheric air, into a vessel termed the exploder. Here they were ignited; and the mixture issued out in a continuous stream of flame against the vanes of a paddle wheel, driving them round with great force. Water was also injected into the explosive mixture to cool the mouth of the vessel; and, by producing steam, to increase the volume of the charge. Barber's engine exhibits, in an elementary form, the principle of what is now known as combustion at constant pressure; but it had neither piston nor cylinder. The next engine, invented by Robert Street, in 1794, was a great step in advance. Inflammable gas was exploded in a cylinder, and drove up a piston by its expansion, thus affording the first attempt at practical internal combustion. The gas was made by sprinkling spirits of turpentine or petroleum at the bottom of a cylinder, and evaporating them by a fire beneath. The upstroke of the piston admitted a certain quantity of air, which mixed with the inflammable vapor. Flame was next sucked in from a light outside the cylinder, through a valve uncovered by the piston; and the mixture of gas and air ignited. The explosion drove up the piston and forced down the piston of a pump raising water. In this engine many modern ideas were foreshadowed—especially the ignition by external flame, and the admission of air by the suction of the piston during the upstroke; but the mechanical details were crude and imperfect.

Two great improvements in the practical application of gas engines were made by Lebon, a French engineer, in 1799 and 1801. The first was most particularly intended to describe the production of lighting gas from coal; in the latter he purposed to utilize this gas to drive a piston in an engine very similar to that designed by Lenoir sixty years later. Lebon also suggested that the machine generating the electric spark should be driven from the motor shaft. More than sixty years elapsed before the great advantages Lebon had so clearly understood, of compressing the gas and air before ignition, were fully realized. Lebon's engine was too much in advance of the times to have achieved immediate success. The manufacture of gas from coal was still in its infancy, and it was too expensive and difficult to produce to be used for driving an engine, while electricity was at that period so imperfectly understood that ignition of the charge by an electric spark was alone sufficient to condemn the motor.

Samuel Brown's inventions came next, his patents being dated 1823 and 1826. The principle used is ingenious and easily carried out in practice. The apparatus consists essentially of three large upright cylindrical vessels, fitted on the top with a movable valve cover of the whole diameter of the cylinder. This cover is raised and lowered from and to its seat, by a lever and suitable gear, at proper times. The gas supply enters the cylinder at the bottom (the cylinder being filled with air); the gas cock is opened, and the issuing gas lighted by a small flame as it enters the cylinder. The flame produced fills the whole vessel, exploding the air it contains. The valve being now lowered and the gas supply shut off, the water jet is thrown in and causes condensation. The engines are all connected to the same crankshaft. The idea was evidently suggested by the condensing steam engine. A boat was fitted with one, including a gas generating plant, and was run on the Thames as an experiment. Another engine was made in combination with a road carriage; and this also ran in London. If these statements are to be relied upon, then Samuel Brown was really a great man, and should be considered as the "Newcomen" of the gas engine.

William Barnett, whose invention is dated 1838, is the patentee of a very good form of igniting arrangement; the flame method, most widely used until a few years ago, being originated by him. He is also the inventor of the compression system now so largely used in gas engines. Lebon, it is true, described an engine using compression in 1801; but his cycle is not in any way similar to that proposed by Barnett, or used in modern gas engines. The igniting valve is very ingenious and the igniter acts well—being almost identical in principle with the flame igniting arrangements of Hugon, Otto and Langen, and Otto.

From 1838 to 1854 inclusive, eleven British patents were applied for, but few of them reached their final stage. Having referred to the Barsanti and Matteucci engine (patent dated 1857), the Otto free piston engine (1866), the Otto silent engine (1876), the Clerk gas engine (1880), and the modern Crossley "Otto" engine (1889), Mr. Norris proceeded: Early in 1890 Messrs. Robey & Co. introduced the manufacture of gas engines into Lincolnshire; the cycle adopted being the now almost universal four cycle, and the combustion chamber so constructed that the inlet and outlet valve are arranged in a direct line of combustion. A peculiarity of the Robey gas engine is the method of igniting the charge. Timing valves, considered absolutely necessary by every other maker of gas engines, are entirely dispensed with, automatic tube ignition being substituted. I am strongly of opinion that there is no known method of igniting a compressed charge of gas and air which gives such satisfactory results as by simply forcing such charge into a tube always open to the cylinder. The cylinder lubricator is arranged with duplicate carriers, and gives a constant feed, irrespective of the level of oil in the reservoir. Messrs. Robey & Co. were the first to show the absurdity of selling gas engines by nominal and indicated horse power, instead of by the effective, actual, or brake horse power; also to prove in a practical sense that gas engines could be made to run in either direction, and give the same results. Independent tests in Birmingham show that with an 18 effective Robey gas engine, a consumption of less than 22 cubic feet per brake horse power was registered. The smallest gas engine made by Messrs. Robey & Co. is ¼-horse power, which runs at 500 revolutions per minute; the largest is 125-horse power, which is intended to work with producer gas on a consumption of less than ¾ lb. of coal per horse power per hour. In Lincoln alone, at the present time, the aggregate power of Robey engines is 340 effective horse power. The "heat account," though commercially good, from a scientific point of

view, is far from satisfactory: Heat turned into work, 22 per cent.; heat rejected in water jacket, 43 per cent.; heat rejected by exhaust, 35 per cent. I am firmly convinced that internal combustion engines will be constructed turning 50 per cent. of the heat into useful work.

In conclusion, the lecturer, in alluding to the internal combustion engine of the future, said: It was Professor Fleeming Jenkin who first gave to the world the mathematical demonstration of the increased economy attending triple and quadruple expansion in the steam engine. Professor Johnston, in his recent paper on "Steam Engines for Electric Lighting," has pointed out the extremely high theoretical attainment of the latest forms. He says, in fact, that these have now arrived at "so perfect a condition that the range for further improvement is probably very narrow, and the gain still to be made must come slowly." The efficiency of the steam engine when taken as a measure of the recovery of power from the total power equivalent of the heat employed, following the most improved methods, is only about 10 per cent. when large units of power are taken into consideration.

To compare this performance with that of the gas engine, it is but fair that we take equal units in either case. In the comparison of the two motors as heat engines, size for size, the actual performance of the gas engine is more than 200 per cent. better than that of the steam engine, with a vast unexplored region beyond in the case of the gas engine, giving promise of great improvement and higher economy than the most excellent performances yet recorded. This system of transferring the furnace, wherein the energy is primarily developed, into the cylinder of the engine itself, and there utilizing directly the benefits of combustion, is undoubtedly the greatest step of the present half-century in the direction of high economy and efficiency. There is no doubt that the engine of the future is to have its furnace in its cylinder, thereby eliminating the gigantic waste attending latent heat, which is encountered in the case of steam. The commercial gas engine of to-day has a single acting cylinder; and it undoubtedly stands in the same position as the steam engine in 1860, when Charles T. Porter first proposed to develop double or triple the power from the same weight of material for the same weight of engine, by increasing the number of its power-producing elements per minute from 50 strokes, as was the practice, to 250; or, to follow history in steam engineering still further back, to the days of Newcomen and Crawley, when all engines were single acting, and a multiplication of cylinders was required to increase the number of power strokes.

Oil Gas.

[A contribution to records of the American Chemical Society, by Messrs. W. A. Noyes, W. M. Blinks and A. V. H. Mory, of the Rose Polytechnic Institute, Terre Haute, Ind.]

Some years ago Armstrong and Miller[1] made a study of the gas made from petroleum by subjecting it to a high temperature, and of the oil deposited on condensing the gas. The following study of the gas made from petroleum by a somewhat different process, and which gives in some respects different results, may be of interest.

In the Pintsch system[2] as described by Armstrong and Miller two D-shaped retorts of cast iron are set one above the other, the largest size in use being 6 feet 4 inches long, 10 inches wide and 9½ inches deep. The retorts are heated to a bright cherry-red, and the oil may be run into the upper retort at the rate of about 12½ gallons per hour. About 80 feet of gas per gallon of oil is considered a good yield.

By the Citizens Fuel and Gas Company, of Terre Haute, gas is made from petroleum in large generators, one having a capacity of about 450 cubic feet of gas per minute, and two smaller ones with a capactity of 250 feet per minute, during the generation of the gas. The larger generator consists of an outer cylindrical shell of ⅜-inch boiler steel, 20 feet high and 8 feet in diameter, lined with firebrick to a thickness of 16 inches. The interior is composed of alternate chambers and checkerwork compartments of firebrick. Starting at the bottom, there is an open chamber to the height of 2½ feet, then, resting upon six 12-inch arches, the checkerwork of brick is built up, rows of brick, touching end to end and 2½ inches apart, extending from wall to wall, composing the first tier, then upon these other rows are laid at right-angles to the first, then the next tier so as to be directly over the open squares formed by the first two rows, and so on, making the checkerwork to the height of 5½ feet. The bricks are laid in, one upon another, without mortar or fireclay.

Above this checkerwork is a chamber 3 feet high, then arches and more checkerwork for 5½ feet, and then another chamber extending to the top. A heavy iron door 14 inches in diameter is provided at the top. By opening and shutting this it is made to act as a regulator for equalizing pressures when reversing operations. For heating the generator, oil is injected into the top and middle chambers by means of a steam-jet, air being admitted at the same points through 5-inch valves. For generating gas oil is injected into the top chamber through three jets. The gas which is formed leaves the chamber at the bottom through a 16-inch pipe lined with firebrick and leading into the water seal. The gas as it leaves the generator is too rich for burning in ordinary burners, hence in the seal box it is diluted with ordinary air injected by steam through a 4-inch pipe into the top of the seal. In the process as formerly used this air was injected into the generator with the oil, and the oxygen which it contained appeared as carbon dioxide and carbon monoxide in the gas produced. This form of the process is still in use elsewhere.

The seal box is 3½ feet in height by 4 feet in diameter, and the pipe leading from the generator dips 8 inches below the water surface. A stream of cold water runs continuously into the seal box, condensing the tar, which is carried with the overflow water into the tar well. From the seal the gas passes through a tower scrubber 20 feet in height, where it is washed with cold water, then through a tubular condenser, from this through a second scrubber, and then through two purifying boxes, 14 x 14 x 3 feet, with a 24-inch seal. From the purifiers the gas passes through the station meter, and thence to the holder. The purifying material used is technically known as Laming's mass, and is prepared by treating wood shavings with copperas and lime, 4 barrels of copperas and about the same amount of lime being used to 300 bushels of shavings.

Temperature.—The destructive distillation of the oil in the process of gas making is an endothermic operation, large quantities of heat being taken up from the hot brickwork, and the operation can only be carried on from 7 to 10 minutes at a time, when the heating must be recommenced and continued for approximately the same length of time.

The temperatures in the generator were measured by noting the melting points of salts. The salt was wrapped in platinum foil; this was placed in a sheet iron tube attached to an iron rod, and the insertion was made through a hole in the side of the generator.

Measurements of the lowest temperature were made by introducing the salts immediately after the gas making ceased, and withdrawing them at the end of 2 minutes. Sodium chloride was unaltered in all trials at the first temperature, potassium chloride fused in about 3 minutes, while potassium bromide melted in less than 2 minutes. The lower temperature is therefore between the melting points of potassium bromide and potassium chloride.

At the highest temperature sodium carbonate fused, but calcium fluoride was unaltered. Experiments with sodium sulphate were rejected because the salt was apparently reduced by the gases to which it was subjected.

In assigning a temperature in degrees, some difficulty is experienced, as authorities differ as regards the melting points of these salts. The following values are given by Carnelly,[1] and quoted in the works of Mills and Rowan on fuels, page 341, and by Victor Meyer and Riddle.[2] The values of the latter, however, are stated as being preliminary only, and the melting point of sodium carbonate especially is stated, in a later paper, to be too high.

	Carnelly.	Meyer and Riddle.
Potassium bromide..... ...	——	715° C.
Potassium chloride.....	734° C.	766° C.
Sodium chloride.....	772° C.	851° C.
Sodium carbonate	814° C.	1,098 C.
Calcium fluoride.....	902° C.	——

The lower temperature may be stated with some degree of certainty as being about 750° C., while the higher temperature is probably 900° to 1,000° C.

Composition of the Gas.—The following determinations of the technical composition of the gas were made with Orsat's apparatus, the determinations of methane and hydrogen being made by explosion with an excess of air and the addition of oxyhydrogen gas, the large amount of methane rendering an explosion with air alone almost impossible. The illuminants were determined by absorption in fuming sulphuric acid. The first two determinations were duplicated with Hempel's apparatus with almost identical results. The "total carbon" in the gas was determined by exploding a known volume of the gas with an excess of air and determining the volume of carbon dioxide formed. The ethylene and propylene are calculated on the assumption that the illumi-

1. *J. Chem. Soc.* (London) 49, 74 (1886).
2. *J. Soc. Chem. Ind.*, 1884, 463. We are indebted to Mr. W. B. Landon, of Lafayette (Ind.) College, for this statement, as the *Journal* is not accessible to us.

1. *J. Chem. Soc.* [London], 1878 and 1880.
2. *Ber. de chem. Ges.*, 26, 2443.

nants consist exclusively of these two gases. It is well known, of course, and will be further shown below, that this is not the case, but for the purpose of calculating the heat of combustion of the gas the error introduced is slight and is certainly less than on the assumption usually made that the illuminants consist entirely of ethylene.

The heat of combustion is calculated on the basis of one cubic foot of the gas at 0° C., burned to carbon dioxide and vapor of water. The following values are used, deduced from the values given in Winkler's "Technische Gasanalyse."

One cubic foot of	ethylene	gives	1,573.3	English heat units.	
" " "	propylene	"	2,324.8	" "	"
" " "	carbon monoxide	"	342.4	" "	"
" " "	methane	"	964.3	" "	"
" " "	hydrogen	"	289.8	" "	"

	Feb. 20. Undiluted Gas. Per Cent.	Feb. 20. Diluted Gas. Per Cent.	May 22. Diluted Gas. Per Cent.	June 5. Diluted Gas. Per Cent.
Carbon dioxide	2.3	2.1	0.7	0.8
Illuminants	28.1	19.9	19.3	15.9
Oxygen	0.2	5.9	7.0	7.7
Carbon monoxide	0.6	1.8	0.0	0.0
Methane	44.8	32.3	33.2	36.0
Hydrogen	20.5	14.2	6.9	6.1
Nitrogen	3.5	23.9	32.9	33.5
	100.0	100.0	100.0	100.0
Total carbon = carbon dioxide.	115.7	85.6	85.5	77.0
Illuminants { Ethylene	16.2	10.3	6.3	7.5
Illuminants { Propylene	11.9	9.6	13.0	8.4
English heat units per cu. ft.	1,025.0	744.0	741.0	678.0

The small amount of carbon dioxide and carbon monoxide present in the gas is worthy of especial remark. Steam is used to inject the oil into the generator, but the analyses show that the steam must pass out at the end almost entirely unchanged. It follows from this that in an atmosphere of reducing gases, and at a temperature of 700° to 900° C., it is impossible to burn carbon to carbon monoxide or dioxide by means of steam.

This is still more apparent in those forms of the process in which air is introduced into the generator. One of us has made many analyses of gases produced in that way, and in every case the oxygen of the carbon dioxide and carbon monoxide combined was less than that of the air introduced. These facts have a very important practical bearing as regards the use of steam with petroleum in the manufacture of gas.

The gas directly from the producer contained 1.83 grains of sulphur per cubic foot. The purified gas contained 0.025 grain per cubic foot.

Efficiency.—The amount of oil required for 1,000 cubic feet of gas varies somewhat with the condition of the generators. The following determinations were made:

1. Feb. 20.—One run of the large generator when it was about to be shut down for repairs.

Oil per 1,000 cubic feet of diluted gas, for heating	2.3	gallons.
" " " " " generating	10.7	"
Total	13.0	"

2. June 5.—Average of 5 runs of the large generator just fitted with new brickwork.

Oil per 1,000 cubic feet of diluted gas, for heating	1.4	gallons.
" " " " " generating	9.7	"
Total	11.1	"

On comparing the analyses, it will be seen that the gas of June 5 was diluted somewhat more than that of Feb. 20, so that the real difference in efficiency is only about 6 per cent. As the oil used was different and that of June 5 was, apparently, of better quality, no reliance can be placed on the difference.

So much time was taken for other parts of the work that these determinations were not repeated so many times as they should have been. Apparently, however, about 10 gallons of oil are used in the large generator for generating 1,000 cubic feet of diluted gas and 1.5 to 2 gallons of oil are used for heating. When we consider the amount of the dilution, these results are somewhat lower than those reported by Armstrong and Miller. Unfortunately they give no analyses of the gas.

The oil used on February 20 contained some water, and an analysis gave—

Carbon	81.0 per cent.
Hydrogen	12.7 "

The specific gravity was 0.843.

The oil used on June 5 was nearly free from water and had a specific gravity of 0.865.

We will take the run of June 5 as a basis for calculating, approximately, the efficiency of its plant. If we assume the oil to contain 86 per cent. carbon and 14 per cent. hydrogen, 1 gallon of the oil would give, when burned to vapor of water, about 140,000 English heat units, and the amount of oil required for the manufacture of 1 cubic foot of gas would give about 1,550 English heat units. Since the gas itself gives 678 units per cubic foot (see analysis), about 44 per cent. of the heating power of the oil is found in the gas.

Without going into the details of calculation, it may be of interest to state that about 35 per cent. of the heating effect of the oil used in heating the generator is lost by reason of the high temperature of the smoke gases, and an approximately equal amount of heat is carried away by the gas during the generation of the latter. It is probable that at least 10 per cent. of the heating effect of the total oil used is lost in this way, though the calculations do not show quite that amount. The remainder of the loss appears to be due mainly to the formation of tar.

Photometric Tests.[1]—On May 21 a test of the candle power of the diluted gas, as furnished to consumers, was made, using a Lummer-Brodhun photometer with a 3-meter bar. The instrument was made by Hartman and Braun. The Methven slit was used as the direct standard, its value being first determined in terms of a standard amyl acetate lamp which was taken as of 1-candle power. A wet meter, which, during one minute, indicated the number of cubic feet burned per hour, was used. Readings were taken on the meter and photometer each minute for 5, and sometimes 10, consecutive minutes. Averages of these readings were made and the gas consumption was corrected for temperature.

The first night, tests were made using an argand, a 5-foot batwing, and a small and large Welsbach burner.

The second night, tests were made with a view to determining the relative efficiencies of different sizes of batwing burners, and of each size burning under different conditions. The conditions chosen were those of a smooth flame with a consumption rather under the indicated amount, and of a large, forked flame burning as high as possible without blowing. The appended table shows the results obtained:

May 22.—Methven = 2.57 Candles.

Burner.	Candle Power Found During the Test.	Rate of Gas Burned per Hour During the Test.	Candle Power Corrected for 5 Feet per Hour.
Argand	29.3	5.17 cubic feet.	28.4
Five-foot batwing.	33.9	5.27 "	32.2
Small Welsbach	31.4	3.25 "	48.3
Large Welsbach	57.13	6.06 "	47.1

May 23.—Methven = 2.36 Candles.

Nature of Flame.	Burner.	As Above.	As Above.	As Above.
Smooth.	2-ft. batwing.	14.20	3.21 cu. ft.	22.12
Forked.	" "	23.32	5.54 "	21.05
Smooth.	3-ft. "	18.53	3.49 "	26.54
Forked.	" "	30.02	6.32 "	23.75
Smooth.	4-ft. "	19.66	3.43 "	28.66
Forked.	" "	37.45	6.74 "	27.78
Smooth.	5-ft. "	28.00	4.47 "	31.32
Forked.	" "	39.88	6.43 "	31.01
Smooth.	6-ft. "	25.01	3.96 "	31.58
Forked.	" "	45.01	7.06 "	31.87
Smooth.	7-ft. "	29.32	4.43 "	33.10
Forked.	" "	53.18	8.27 "	32.15

It will be seen that the larger burners are most efficient and that, with one exception, the smooth flame gives better results. This is especially true of the smaller burners. A sample of the gas taken on May 22 gives for the calculated heating effect 741 English heat units. The statement of the analysis is given elsewhere.

Composition of the Illuminants.—In order to determine the presence and the amount of benzene and similar hydrocarbons in the gas, these were determined by a modification of the method of Hempel and Dennis,[2] and also by absorption in absolute alcohol and subsequent dilution with salt water. Both methods gave essentially the same result and showed that about 1.2 per cent. by volume of the gas consists of the vapor of these hydrocarbons. From the oil obtained by the second method pure metadinitrobenzene was easily obtained by nitration and crystallization.

To determine the composition of the other gases forming the illuminants, gas directly from the generator was aspirated through an ab-

1. These tests were made with instruments from the Physical Laboratory, and under the direction of Prof. C. L. Mees.

2. See JOURNAL, *ante*, p. 515.

sorption train consisting of 2 one-liter bottles packed in ice to condense the tar, then 2 one-half liter bottles half filled with an ammoniacal solution of cuprous chloride to absorb acetylene; next a bottle of the same size half filled with dilute sulphuric acid to absorb ammonia fumes from the cuprous chloride solution; next 3 Drechsel wash bottles standing in ice water, the first two containing 100 grams each of bromine with about half an inch of water above, and the third containing distilled water for the collection of bromine carried over from the other two, and finally a wash bottle half full of a solution of sodium hydroxide to absorb bromine fumes. Approximately 125 liters of gas were passed through the train to effect the saturation of the bromine.

The bromine compounds were washed twice with caustic soda, then with distilled water, were separated, dried with calcium chloride, and fractioned. More than one-half came over between 127° and 150°. The residue remaining in the distilling bulb solidified on cooling. It was crystallized from alcohol and from ligroin when it melted at 113°–113.5°. An analysis gave the following results:

0.0750 gram gave 0.1500 gram AgBr.

	Cal. for $C_4H_6Br_4$.	Found.
Br.....	85.56	85.11

Armstrong and Miller[1] obtained a bromide melting at 116°, which they considered to be divinyl tetrabromide (1, 2, 3, 4 tetrabrombutane). The substance described above was probably the same, but less pure, as we have worked with much smaller quantities.

The portion of the bromides boiling from 127° to 150° was redistilled and gave three fractions, the largest 129°–133°, that from 133°–139° next, and that from 139°–143° least. After fractioning again, a determination of the molecular weight by the air displacement method of Victor Meyer was made with the portion boiling at 130° to 133°. The results agreed fairly with the molecular weight of ethylene bromide. Determinations of the molecular weight of the fraction 140°–143° were unsuccessful owing to decomposition of the bromide. There can be little doubt, however, that the bromides consisted chiefly of ethylene and propylene bromides, the former being present in much larger amount than the latter.

A considerable precipitate was obtained in the ammoniacal solution of cuprous chloride, indicating the presence of appreciable amounts of acetylene and its homologues. In this respect our results differ from those of Armstrong and Miller.

Tar.—The amount and character of the tar vary considerably with the conditions of running. Two samples of the tar were examined, one which was thick and viscous, another which was comapratively thin. No essential difference in qualitative composition was established. The lower boiling substances contained in the tar were separated by distillation with superheated steam, the higher boiling products by direct distillation. In the direct distillation much trouble was experienced from frothing, and it was found necessary to heat the tar at first in small quantities in an open dish until the frothing ceased. The residue was then distilled as usual.

Without going into the details of the work the results of the study may be stated briefly as follows:

Benzene and its lower boiling homologues appear to be present in the tar in only small amount. No positive evidence of their presence was obtained, although it has been shown that benzene is present in the gas.

Naphthaline is present in considerable amount and was identified by melting point and boiling point.

Anthracene is also present and was identified by melting point and by conversion into anthraquinone. An approximate quantitative determination of the amount of anthracene was also made, showing the presence of about 0.35 per cent.

From the portion coming over at about 425° there was obtained, by crystallization, a solid melting at 250°, and probably crysene.

From the portion boiling still higher a green crystalline solid melting at about 240° was obtained, but not in sufficient amount for its identification.

Attempts to isolate phenol were unsuccessful, though it is probably present in small amount.

The results of the investigation confirm the conclusion of Armstrong and Miller that benzene and allied hydrocarbons may be formed, at high temperatures, from hydrocarbons which bear no simple relation to them.

In conclusion, we wish to express to Mr. J. J. Kirkham, Superintendent of the Terre Haute Citizens' Fuel and Gas Company, our thanks for many favors shown us in the course of the work.

1. *J. Chem. Soc.* (London) 49, 81 (1886).

How Shall We Meet the Competition of the Welsbach Burner?

Mr. Ed. M. Highlands, having asked the above question in *Electrical Engineering*, thus answers it:

The competition forced by the introduction of the Welsbach burners, how to meet it and satisfy the customer with profit to the station, is a subject of interest to all station managers.

Where coal is used in quantities, coal consumption practically regulates the price of the output, and is the most important of details, making it the great thing to economize upon. This being a fact, to compete with gas we must get an equal amount of light, in candle power, per pound of coal used, or be able to deliver the product to the consumer at a proportionately cheaper rate than gas is being delivered.

The committee on statistics of the National Electric Light Association report 208 watt hours per pound of coal as the best duty, and gives the average of 65 electric light plants as 91.6 watt hours per pound of coal. This average is entirely too low to use even in an argument. So we will take the best showing made, namely, 208 watt hours. This 208 watt hours will supply current sufficient for 3.7 incandescent lamps of 16-candle power each, of the type known as the 3½ watt per candle power efficiency, making a total of 59.2 candle power per pound of coal. The same amount of the same kind of coal consumed in a gas works will yield 4 cubic feet of gas. The Welsbach burner consumes 3 feet of gas per hour and gives a 60-candle power light, or the equivalent of 80-candle power per pound of coal.

An electric light plant having a capacity of 2,000 16-candle power incandescent lamps, and 275 2,000-candle power arc lamps, corresponds to a gas works making 23,000,000 cubic feet of gas annually. The former's labor account, not including superintendency and office help, would amount to $455 per month, divided as follows:

Two engineers, $130; two firemen, $80; one helper, $40; two trimmers, $90; one lamp repairman, $50; one wireman and foreman, $65. The labor account for the gas company will amount to $240, divided as follows: Two stokers, $90; one street man, $50; one meter setter, $50; one statement man, $50. The cost of the two plants will be practically the same if the same amount of territory is covered.

A gas company never figures over 2½ per cent. of depreciation, as the holders, with proper care, should last for years; the mains never wear out, simply get too small for the increased consumption, which requires larger mains, laid alongside the old ones. Generators, either retorts or cupolas, scrubbers, purifiers and exhausters, require a very small amount of repairs. The meter account will be a trifle smaller than the transformer account on an alternating system.

Electric companies figure at least 10 per cent. depreciation, and cannot honestly figure any less than that. Some of our largest arc light stations make an allowance of at least $2.50 per lamp per year for burnt out dynamo armatures alone.

Having compared gas and electricity as applied to commercial lighting, we will now sum up the advantages of each one, and see how electricity is going to compete with gas. Electric illumination has the following advantages: Entire freedom from smoke and heat; convenience and safety, which, with a neat, ornamental appearance, commend it to everyone for residence lighting. Then with the alternating current systems outlying areas some distance from the central station can be supplied at less first cost than with gas. But gas can be so made as to give 74 per cent. more light per pound of coal, and a saving can be effected of 50 per cent. in salaries and 80 per cent. in repairs and in depreciation. And the same mechanical efficiency secured, whether working at full load, one-half load, or quarter load.

Electricity is being sold as cheap now as it is possible with present machinery. Gas can be sold from 25 to 50 per cent. less than at present and still leave a good margin for the shareholders.

How can electric light companies best meet this competition?

The Storage Battery from the Standpoint of the Purchaser.

By Mr. Townsend Wolcott.

The first question which prospective purchasers of storage batteries wish to have answered is, will it pay to invest in batteries, and if so, how large an investment will pay, under given conditions? Broadly speaking, the place to employ storage batteries is anywhere where there is a surplus of power at one time and a deficiency at another, or where a portable reservoir of electric energy is required. In any given case the question of practicability from a technical or engineering point of view must first be decided, and then in case of a favorable answer the financial part must be considered.

As with most other questions of engineering, the first part is more easily answered than the second. This distinction may appear to some unimportant, or even trivial, as the ultimate test of all engineering enterprises is the commercial one, yet, nevertheless, it is important to know whether it is a question of natural law or of dollars and cents which is to be decided. Should a question arise as to the feasibility of building a bridge with a longer span than any heretofore built, well informed persons would first ascertain if it were possible to build the proposed structure at all, and if it were possible they would then consider whether the cost of building would be warranted by the amount of business that could possibly be secured.

When it was announced some years ago that all that was needed to make a successful flying machine was a motor with a total weight per horse power considerably less than any motor then in use, some one suggested storage batteries. This was on its face absurd, as no one with the slightest knowledge of storage batteries would expect them to excel all other reservoirs of energy in lightness. So the question of cost need not be considered, and the possible cheapening in future has no bearing on the case, but the discovery or invention of a very much lighter battery would be necessary before this use could be considered seriously. This may perhaps be thought to be too visionary a scheme to be mentioned in a practical article as an example of proposed uses of the storage battery, but it is a fact that it is only a fair sample of the things that were expected of the storage battery by the public at the time of the greatest storage battery enthusiasm. The public is now less enthusiastic, but in a better humor to do sober business.

In the field of traction it has been claimed by some that the storage battery is too heavy, but it will be found that the additional weight of batteries does not increase the total weight of a car in as large a ratio as is commonly supposed, and although a lightening of batteries for a given power would, of course, be advantageous, this alone would not make the difference between success and failure. An investigation of most of the cases where storage traction has been successful would show that it was a question of finance that determined the success or failure.

Traction work is the severest possible work for a battery, owing to the large and rapid fluctuations of current, and under these conditions the deterioration of the cells has been the chief difficulty. The production of a type of cell that could stand the hard usage with a small amount to be charged to deterioration, would materially increase the number of cases of practicable storage traction. Other questions would then have to be considered, such as whether the road would have to compete with the trolley or not.

One of the principal uses to which the storage battery has thus far been applied with entirely satisfactory results is the supplementing of the dynamos in central stations. For this purpose the engineering part of the question of feasibility can almost always be answered in the affirmative, and it is then purely a financial question. If a station runs all the hours of the 24, it is important to have the load as uniform as possible, and for the purpose of performing this equalization storage batteries are giving perfect satisfaction in European stations, and with the result of a visible improvement of the balance sheets. The batteries are charged from the dynamos during the slack hours, and discharged in conjunction with the dynamos during the heavy load hours.

It is claimed by some American engineers that the load diagram in American stations is so even that there is no room for the advantageous use of batteries. But although this may be true of some stations, and although it is admitted by European engineers that our stations have on the average evener loads than theirs, there is undoubtedly a good deal of opportunity for their economical employment. It is the practice of some of the best battery makers to guarantee batteries on specific work for annual depreciation not exceeding a given amount. It is then possible to calculate with more certainty whether storage batteries will pay in a given case. The items to be considered in estimating the operating expenses are, then, interest on investment, depreciation and attendance. The estimate of saving is based on the increased efficiency of the other apparatus, after allowing for the loss in connection of that portion of the energy which is passed through the batteries. In addition to this there is sometimes a saving which is not so easy to estimate beforehand, which, however, shows in the long run. This is the increased capacity of the stations to provide for emergencies, such as sudden calls for more power than the usual demand or the stoppage from any cause of a portion of the machinery.

If a station does not run all the hours of the 24, it sometimes has a load diagram that can be improved by the use of storage batteries, by shortening the actual hours of running the machinery and running more fully loaded during those hours. As this is in a sense opposite to the other method proposed, it is important to understand the principle on which it is proposed to operate. If the maximum load of the station is above the most economical working load, the batteries may, of course, be used after the method described for 24 hour stations. But there are many smaller stations where the maximum load is not above the economical point, and according to the general notion there would be no room for batteries. In this class of stations, if the spare power be kept at work charging batteries at all times when there is any spare power, there will arrive a time when the batteries have sufficient charge to take care of the remaining hours of light load, and then the machinery may be stopped, with a reduction of operating expenses. In such a station, if the business increases so as to give a maximum load which is too high for economical running, the batteries may be used partly in both ways, and there is no danger of their becoming useless by a gain in the amount of business.

The use of storage batteries for the propulsion of small boats or launches is an undoubted success. The work is not so arduous as in the case of street car traction and the depreciation is small. There is, moreover, no competitor in this field, unless the primary battery be considered as such. The electric launch business is, perhaps, not a large field, but it has been in several instances a very profitable one.

In selecting storage batteries for different uses it is important to note the different capacities per pound weight of the complete cell. Where lightness is an important consideration, of course the cell with the largest output per pound must be used, but where extra weight is of not much importance, some of the heavier types should be used, as the depreciation is less. The figures given by different makers vary from about 2.5 watt hours per pound of cell complete up to 11.9 watt hours. This latter figure is equivalent to about 63 pounds of cell per horse power hour.

Large cells built specially for station purposes sometimes have their containing vessels built of heavy planking and lined with lead, which increases the weight, so that the output will sometimes be as low as 2 watt hours per pound. This, however, is no disadvantage for station purposes, and the cheapness and solidity of the wooden tanks, as compared with glass or rubber, make their use advantageous. These figures are for the ordinary lead and sulphuric acid types, known as Plante and Faure cells, and the highest figure, 63 pounds per horse power hour, is about the same as the alkaline battery at its best. The alkaline battery consists of zinc and porous copper in caustic alkali. These batteries give a much greater current per pound weight than any other, and would seem to be the ideal ones for traction purposes, until the low electromotive force is considered, when it is found, as just stated, that they do not exceed the best results of the lead battery for power.

It is a remarkable fact that the first type of storage battery that was of any practical importance, made in 1860 by Plante, is to-day, with some modifications, among the best, and both for durability and for high capacity it is unexcelled. The Faure process of mechanically applying oxides, instead of forming them by the current, expedited and cheapened the process of manufacture as conducted at that time and increased the capacity of the cells; but the improvements in the Plante type brought it to the front again. The zinc-lead-sulphuric acid battery is lighter for a given output in horse power hours than the lead battery, on account of its higher electromotive force; but the maximum discharge that can be taken from it without injury is probably not so high as in the case of a good Plante cell, so that it is no better for traction and similar purposes than the latter.

Mayer's Apparatus for Manufacturing Gas.

On July 17, 1894, U. S. Letters Patent (No. 523,224) were granted to Mr. Frederick Mayer, of Baltimore, Md., for an improved system of manufacturing gas. Using the words of the specification:

Figure 1 is an exterior front elevation of the apparatus. Fig. 2 is an exterior end elevation. Fig. 3 is an enlarged longitudinal central sectional elevation of the same. Fig. 4 is a transverse section of Fig. 3, taken on the dotted line v—v, except that a part of a conduit hereinafter described, and the adjacent brick wall, are shown in section. Fig. 5 is a sectional plan of Fig. 3, taken on the dotted line w—w. Fig. 6 is a similar section of Fig. 3, taken on the dotted line x—x. Fig. 7 is an exterior plan of the apparatus. Figs. 8 to 14 inclusive, are details of the apparatus on an enlarged scale.

Referring to the drawings, A and B are circular twin generators. The wall of the generators is formed of brick of different qualities, the inner circular shell b being of firebrick of the highest grade, the outer circular shell c of a cheaper grade, and the filling-in d of common brick. The entire wall is incased in sheet iron. The portion of the wall

situated between the generators is cut away to form the connecting space *C*, see Fig. 3. At the bottom of each generator are grate bars *e*, and below these bars are ashpits *f*.

D and *E* are conduits extending transversely through the brickwork near its bottom, and the ashpits *f*, and these conduits are connected by ducts *g* and *h*.

The generator *A* has a feed opening *F*, covered by a valve *i*, which is sand sealed, and the generator *B* has a similar opening *G*, provided with a purge valve *j*, over which is suspended a hood *H* shown only in Fig. 1. The purge valve is manipulated through the medium of sprocket wheels a^4 and b^4, rods c^4 connected at their ends by chains d^4, and the lever e^4 on the shaft of the sprocket wheel b^4.

I is a pipe leading from the conduit *D* into the hydraulic main *K*, see Figs. 8 and 9.

L is a pipe similar to the one *I*, leading from the conduit *E* on the opposite side of the generator to the hydraulic main, see particularly Figs. 2 and 7.

M and *N* are branch pipes leading, respectively, from the pipes *I* and *L*, to the main blast pipe *O* which extends to some source of supply of air under pressure.

Q and *R* are stop valves respectively in the pipes *M* and *N*. These valves are best shown in Figs. 2 and 7. The stem a^3 of each of the valves *Q* and *R* is attached to a spindle b^3, united to a double or branched arm c^3 of a lever *P*, the other arm e^3 of which is loosely connected to a vertical rod f^3. A similar rod g^3 is attached at the upper and lower ends to the one f^3 by chains h^3 which pass over sheaves i^3, thus making an endless connection. The rod g^3 is operated by a hand lever P^1 hinged to the sheet iron casing around the brickwork of the generators.

T is a main steam pipe leading from a boiler not shown, to the main steam valve *n*; and *U* and *V* are branch steam pipes extending from the main steam pipe *T* below the valve *n*, to the ends of the conduits *D* and *E* which are opposite to the pipes *I* and *L*, and which are closed by heads *o* and *p*, see Fig. 7. The valves in the steam pipes *U* and *V* are, respectively, denoted by *q* and *r*.

W is a purge steam pipe, controlled by a valve *s*, branching from the main steam pipe *T*, and leading to the upper part of the interior of the generator *A*, see Fig. 3.

A shaft *t* stepped in the head of the main blast pipe *O*, extends upward to a point above the generators where it enters a suitable bearing box *u*, and it carries a beveled gear wheel a^1 in engagement with a similar wheel b^1 on a countershaft c^1 hung in brackets d^1. At the outer end of the countershaft c^1 is a sprocket wheel e^1 united by a chain belt to a similar sprocket wheel f^1 on a stud k^3 having a second sprocket wheel l^3 united by a chain belt to the sprocket wheel m^3 on a spindle A^1, which serves to operate the dip valves in the hydraulic main *K* as hereinafter described.

B^1 is a short, vertical revoluble shaft situated near the shaft *t* and connected to the said shaft by means of two spur gears g^1 and h^1, see particularly Figs. 11, 12 and 13. At the upper end of the short shaft *B*^{1} is a worm i^1 in gear with a toothed sector j^1 on a rockshaft k^1 having a double pointer m^1, see Figs. 11, 12 and 13. The pointer m^1, when in a horizontal position, is either below the valves *q* and *r*, as shown in Fig. 2, or above them, as shown in Fig. 11. When, however, the pointer is inclined in either direction to its fullest extent, it indicates one of the valves *q* and *r* as hereinafter fully described.

Referring to Figs. 8 and 9, it will be seen that the pipes *I* and *L* in the hydraulic main *K* extend through the contained water into cylindrical boxes *C*^{1} and *D*^{1}, in which the dip valves *E*^{1} and *F*^{1}, before alluded to, are situated. Fig. 8 is a section of Fig. 10 taken on the dotted line *y*—*y*. Fig. 9 is a section of Fig. 10 taken on the dotted line *z*—*z*. These dip valves *E*^{1} and *F*^{1}, which cover the pipes *I* and *L*, consist of cylindrical

Fig 1

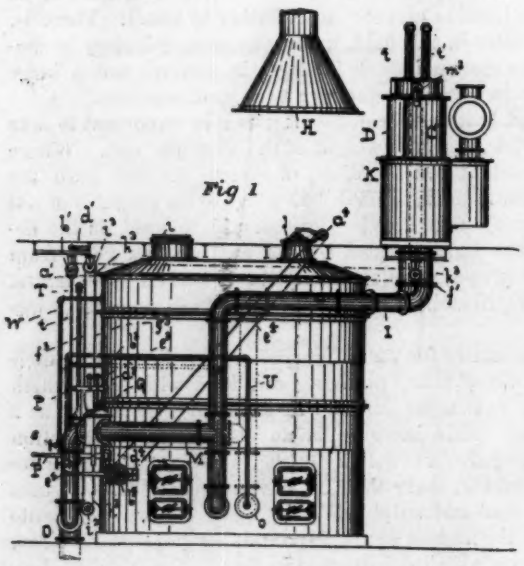


Fig 2

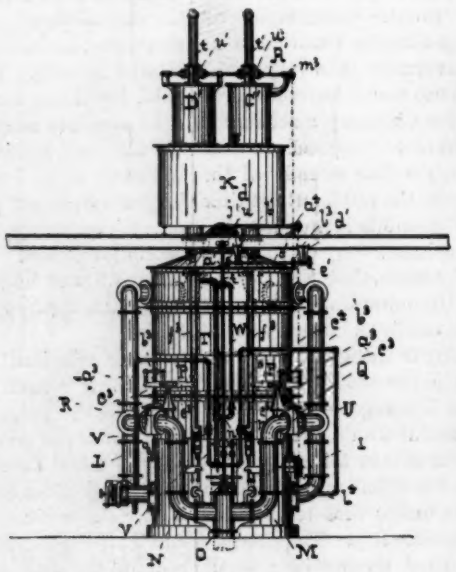


Fig 5.

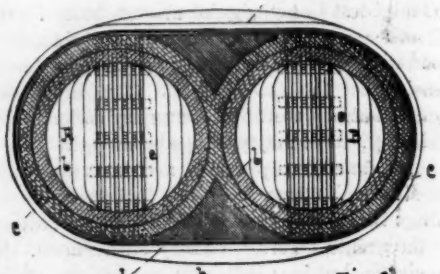


Fig 6.

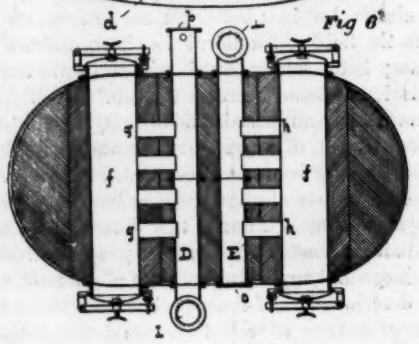


Fig 3.

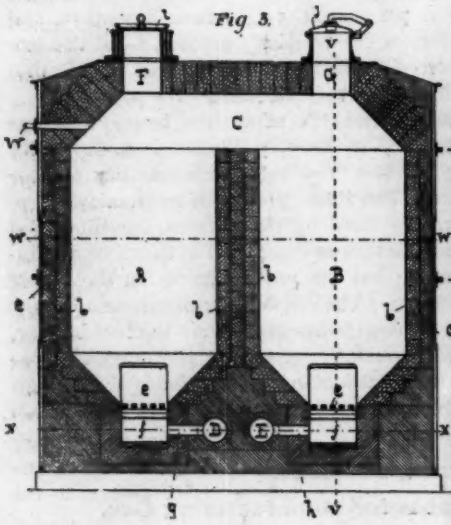


Fig 4.

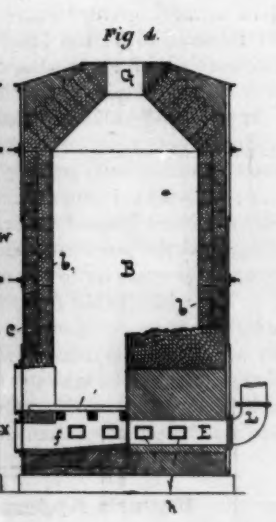


Fig 7

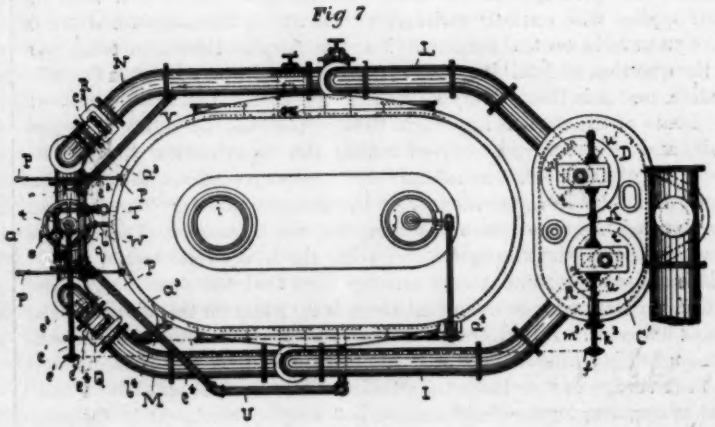


Fig 8.

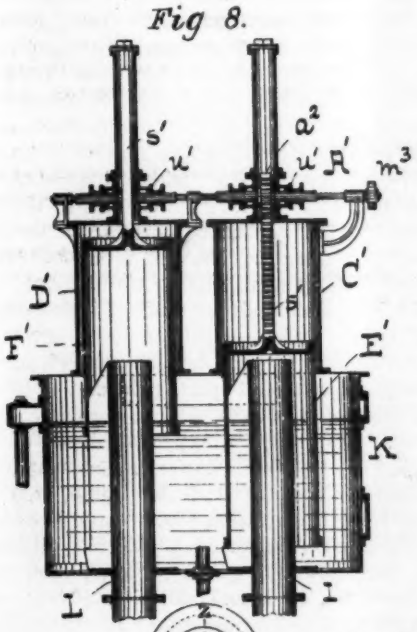
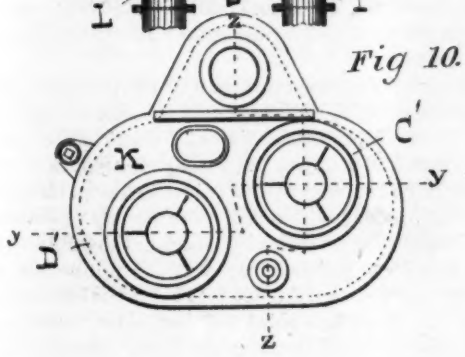


Fig 10.



shells closed at the top, and at the bottom immersed in the water of the hydraulic main, see Figs. 8 and 9. Extending from the dip valves E^1 and F^1 are racks S^1, which pass through the heads of the cylindrical extensions C^1 and D^1 of the hydraulic main K and into closed tubular cases t^1. The spindle A^1, before alluded to, passes through the bases of the tubular cases t^1, which are enlarged and provided with stuffing boxes u^1, to prevent leakage of gas. Within the enlarged portions of the cases t^1 are pinions a^2, secured to the spindle A^1, and in engagement with the racks s^1, see Figs. 8 and 9.

Referring now particularly to Fig. 10, which is a plan of Fig. 8, it will be seen that the pipes I and L, with their dip valves E^1 and F^1, are not situated on the longitudinal center line of the hydraulic main, but are placed one on each side thereof. The object of this arrangement is to have the pinions a^2 on opposite sides of the racks, so that in the rotation of the spindle A^1 one of the valves will be raised as the other is lowered. At the back of each rack s^1 is a supporting roll b^2, which prevents the rack from being forced back in the operation of the spindle A^1, see Fig. 9.

Supposing the feed and purge valves i and j to be open, the steam valves closed, and the dip valves E^1 and F^1 in the hydraulic main equalized in height, the first step in making gas consists in charging the generators with lump anthracite coal, coke or other carbonaceous material through the openings F and G, and bringing the coal to an incandescent state by the air blast admitted to it under the grates, through the pipes M and N, and conduits D and E. The air blast is now shut off, the openings F and G closed, and the dip valves E^1 and F^1 brought into the relative positions shown in Fig. 8, when the main steam valve n and the branch steam valve r are opened, which admit steam to the generator A by means of the conduit D and the ducts g. The steam passes upward through the incandescent coal in the generator A, and in this operation is disassociated into its elements, the oxygen combining with the coal forming carbonic oxide and the hydrogen being liberated. These gases then pass through the connecting space C to the generator B, thence through the incandescent coal in the said generator, thence to the conduit E by means of the ducts h, and thence to the pipe L, through which they are conducted to under the dip valve F^1, and are delivered through the water to the hydraulic main. The operation as described is continued until the coal in the generator A becomes somewhat cooled, when the steam valve r is closed and the dip valves E^1 and F^1 reversed in position. The steam valve q is now opened, and the operation above described repeated, except that the process is reversed, the steam passing upward through the generator B

Fig 9.

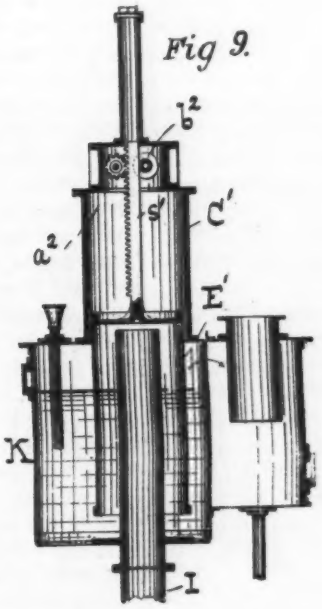


Fig 11.

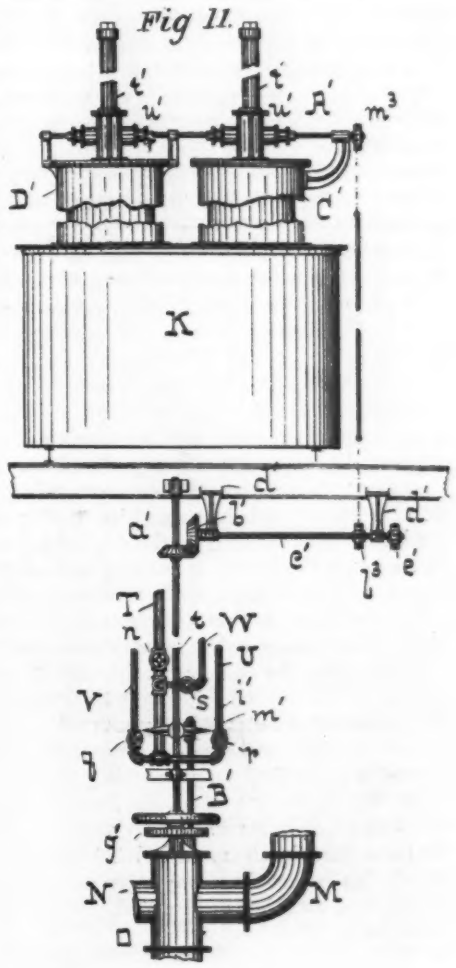


Fig 12.

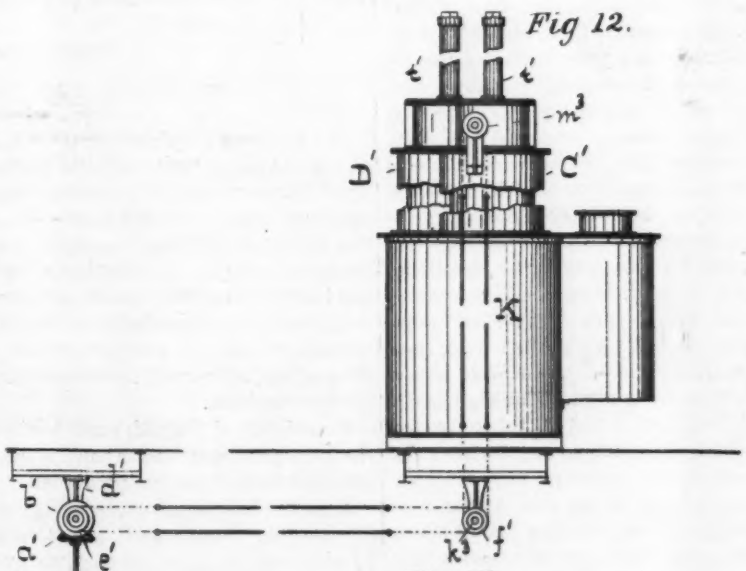
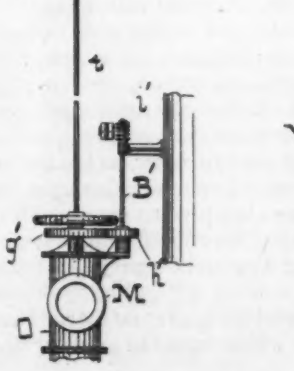


Fig 13.



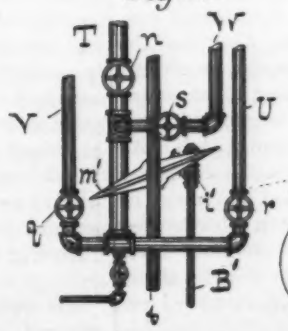
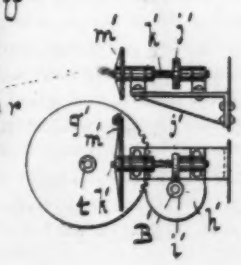


Fig 14.



and downward through the one *A*, but the gases finally pass from under the dip valve E^1 to the hydraulic main, as in the first operation. This secondary process is continued until the coal in the generator *B* has been cooled to a point below which the operation cannot be properly worked, when the steam valve *r* is closed. The purge valve *j* is now opened, as are also both the steam valves *q* and *r* to drive out through the opening *G*, the inflammable gases contained in the generators. This purging process is completed after the closing of the steam valves *q* and *r* by admitting steam through the purge pipe *W*. The purge being still open the air blast to both generators is turned on, and this is continued until the coal in both generators is again heated to an incandescent state or a proper temperature, after which the first and secondary processes as described are repeated.

It will be understood from the foregoing description that in operating the dip valves E^1 and F^1 in the hydraulic main, to change them from one extreme position to another, or to bring them to a common position wherein the depth of dip is equal, the double pointer m^1 is also and simultaneously moved, in other words, all move together. For instance, when the said dip valves are equalized in height or have the same dip, the pointer is in a horizontal position, which indicates to the attendant that the apparatus is in a condition for the application of the blast, the dip valves both offering by the depth of seal sufficient resistance to the escape of air to prevent its passing to the take-off pipe of the hydraulic main, and also to prevent the backward passage or return of gas from the hydraulic main to the generators. It also indicates that both the steam valves *q* and *r* should be or are closed.

In adjusting the valve operating mechanism by means of the hand wheel, so as to open or elevate to its highest position the dip valve F^1, the pointer m^1 is automatically moved so as to point to the steam valve *r*, and by this the attendant knows that the steam valve *r* must be opened in order that the gas making process may be carried out. To effect the secondary process, the hand wheel is turned in an opposite direction so as to lower the dip valve F^1 and raise the one E^1, and at the same time the steam valve *r* is closed. The position of the pointer now indicates that the steam valve *q* is to be opened. Thus, the pointer always indicates the position of the dip valves, and shows which steam valve has to be opened.

Cost of Coal Mining in Iowa.

By Mr. G. A. Davis.

The developed coal field of Iowa lies in 24 counties, and some of these have produced only small amounts. Of the entire field, Mahaska is the banner county, producing 1,172,530 tons in the year ending June 30, 1893. Most of this coal is a good quality of steaming and fuel coal, easy of access and workable. Many of the mines are developed by drift or slope entries. Of the shaft mines none is over 250 feet deep, while the principal ones are 125 feet or less. The thickness of the veins runs from 3 to 8 feet, and even more. The coal is worked by both the room and pillar and the long wall systems, the former plan being the most used, because it requires a peculiar roof for the long wall system, and, where it can be used, is considered the best, being safer, requiring less timbering, and removing a larger per cent. of coal. The average cost of sinking a shaft is about $12 per foot in depth; the cost of timber with 4-inch stuff is $3 to $3.50 per foot in depth; air shaft, 5 × 10, costs about $10 per foot in depth. Main entries are about 7 feet wide at the bottom and 6 feet at the top, not less than 5 feet high, or as high as the coal vein is thick. When the vein is less than 5 feet in thickness, top or bottom is removed to give this height. Side entries may be less. In long wall working enough of the entry roof is removed to make gobbing or packing on the sides, and the settling of the roof causes it to lock or key itself before it has settled more than half the height it was excavated. The timber used for mine props is an item of expense that varies with the conditions met with in each mine. They cost 1 cent per lineal foot, delivered at the mine, for 4-inch diameter at the small end.

The miners usually work in pairs, two men per room. They load the coal into pit cars, which the company hauls out and empties on screens of diamond-shaped bars set 1¼ inch apart and 12 feet long, set at an angle of 26°, or ½ to 1. Accompanying each car is a numbered brass check, which is credited with the weight of lump coal sent with it. As an incentive to good work, the nut and slack are not paid for. Some men shoot the coal to pieces more than others, and good judgment in digging coal counts in dollars and cents here, as well as in other trades.

In What Cheer, iron men (picks work by compressed air) have been introduced. With this machine (the Harrison) a man can cut under about 40 ft. face 4 ft. deep in a day. He will have one or two assistants, whom he pays a stipulated price per day, and he gets credit for all the coal he sends out. The company furnishes the machines and the compressed air and pays all expenses connected with them. Entry work, on an average, costs by hand pick $1.80 per lineal yard and 75 cents per ton of coal removed. With machine it costs $1.50 per lineal yard and 40 cents per ton. The proportion of nut and slack to lump coal in Keokuk county is about as follows: Slack, 10 per cent.; nut, 15 per cent.; and lump, 75 per cent. Ventilation is by fan in the large mines and by steam jet or furnace in the smaller ones. The fan forces air into the mine, which is carried around through the various side entries and rooms by a system of stoppings in the entries until it reaches the upcast shaft. The furnace or steam jet is placed at the bottom of the upcast shaft to create a draft from the workings. The coal is usually hauled to the bottom of the hoisting shaft by small, chunky mules, but in some cases the endless rope and tail rope methods are used. Pit cars usually hold about 1,500 to 2,000 pounds each, and run on track of 2 feet 8 inches to 3 feet gauge, laid with 12 to 18 pounds per yard T-rail, laid on 2½ × 4 inches oak cross ties placed 2 feet apart. The cost of a first-class plant for operating a mine of say 500 to 800 tons per day capacity is approximately as follows: Main shaft, 7 × 15 per foot depth, $15; air shaft, 5 × 10 per foot depth, $10; top works, tower, screens, cages, tipples, etc., $4,500; two boilers in place, $2,000; boiler house, $300; engine, $2,000; engine house, $300; track scales, $800; pump, pipes, etc., $500; sixty pit cars, $20 each, $1,200; blacksmith shop, $200; oil house, $100; powder house, $100; fan, $200; fan engine, $250; house, $150; rails, spikes, etc., $500; hardware, tools and sundries, $2,500; total, $15,625. If machine picks are used, add for air compressor, $4,000, and for eight machine picks, $3,200.

This plant will require about 13 top men at a cost of $25 per day, and 16 to 18 men, including mule drivers, underground, at a cost of $30 to $40 per day, and from 150 to 250 miners. Patent loaders cost about $1,500, and if the coal is clean and requires but little picking over, they are a good investment, as they save the work of from 4 to 6 men, chunking in box cars, where the mine loads 400 tons or more per day. Besides, they place the load over the car trucks instead of leaving the bulk of it piled in the center of the car. The railroad tracks at the mine should have a grade of 1.5 per 100 feet from a point 100 feet below scales, to the end of empty storage tracks. From this point 100 feet below scales it should have 300 feet of 1.0 per 100, and lesser grade from there on, or even level if the ground will admit of it. Steeper grades than 1.05 per 100 are liable to cause trouble in bad weather, while less grades on the empty track and over the scales cause cars to move hard in cold weather; and the availability of these grades should be kept in view when locating the hoisting shaft.

Beehive and Bye-Product Coke Ovens.

The *Colliery Engineer* remarks that it is a matter for some surprise that up to the present but little has been done in the United States towards the recovery of the bye-products of coke manufacture. It now, however, seems probable that some important forward movement in this direction will soon be made. Two circumstances are operating to bring this about. The first is an absolute necessity, which is manifesting itself, for largely increasing the supply of ammonia in America for refrigerating and fertilizing purposes; and secondly, the low prices to which coke and pig iron have fallen, and the importance to iron and coke manufacturers of increasing their profits by securing the value of the bye-products.

Experience of English and Continental coke manufacture under the recovery processes, shows that the profit is nearly $1 per ton of coke, obtained from these bye-products.

A party of experts, instructed by the United States Geological Survey (Technology Department), are at present in England, personally investigating how far these bye-product ovens are applicable to American requirements. They are visiting most of the leading coke and iron works in England, and expect also to visit France, Germany, Switzerland, and perhaps Belgium. The beehive oven is the only pattern extensively employed in America, and one of the main objects of the visit is to ascertain whether coke made upon the modern system would be equally as satisfactory in the manufacture of pig iron under the fast driving of American blast furnaces, as the fuel now supplied.

A diversity of opinion exists upon the relative value of cokes made in beehive and bye-product ovens. This is a matter of the gravest importance to this country with its large output of pig iron.

Even in England the prejudice against the bye-product ovens exists amongst some of the leading ironmasters.

It is especially important that no change should be made in coke manufacture, which would in any way decrease the output, which at some

furnaces is as much as 3,000 tons per week against two-thirds of this quantity in England under the best practice. The recovery processes divide themselves into two systems, one, the Otto Hoffman (or Coppee) system, with its vertical flue oven and Siemen's regenerator, and the other the varied modifications of the Carves oven, with its distinguishing horizontal flue. The bye-products sought to be obtained are coal tar, ammonia and gas, the latter being used for continuous coking and other heating purposes about the plant. In the north of England the Simon-Carves oven is mainly used, while at Northwich, near Liverpool, the Semet-Solvay ovens are used for the production of ammonia for the manufacture of ammonia ash.

In France the Carves process is, of course, almost universally adopted, while in Germany the Hussener system, which is an adaptation of the horizontal flue, prevails. With a view of making the investigations most thorough, some 600 tons of coking coal has been shipped to France from the Pennsylvania, Ohio and Illinois coal fields, which will be tested in the presence of the Commissioners, and it is understood that a leading English ironmaster has offered to afford special information, under the head of "The Behavior of Bye-Product Coke in the Blast Furnace," by running part of his plant exclusively with bye-product coke and noting the results in the effect upon the production. No doubt is entertained but that the output will be larger with any of the coals sent over, in the bye-product oven, than would be produced by them in the beehive, but the question at issue is whether the quality will show a deterioration by the newer process.

For instance, coal from the Connellsville region will yield 66⅔ per cent. of coke in the beehive ovens, while it is confidently expected the yield by the bye-product oven will be 73 or more per cent.

The cost of a complete plant of 60 ovens, together with the necessary recovery plant and apparatus for treating sulphate of ammonia, is estimated to be from $120,000 to $240,000, varying with the style of the ovens. How much more costly these are compared with the beehive ovens will appear when it is stated that 60 ovens of the latter type cost in the Connellsville region but $20,000.

This must be borne in mind, however, that the output from a bye-product oven is about 2½ times that of a beehive. The bye-product ovens are nearly all of them, whatever the system, long and narrow—25 to 30 feet long by 5 to 7 feet high, 16 to 28 inches wide—with external heating, rendering them practically gas retorts.

The result of the examination and tests made by the Commissioners will be awaited with considerable interest, as the amount of information gathered will probably be more complete and detailed than has yet been accumulated, of the most approved European devices for the manufacture of coke, and they may result in a far reaching consequence to the iron, steel and coke industries of this country.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE annual meeting of the shareholders of the Consumers Gas Company, of Toronto, will be held at noon of the 29th inst.

THE annual meeting of the Troy (N. Y.) Gas Company will be held in the Troy Savings Bank building on the 17th inst.

MR. ERNEST F. LLOYD, Secretary of the Western Gas Construction Company, is receiving the congratulations of his friends; and well may they be tendered, for he was recently in a wreck on the Wabash Railroad, the smashup occurring at a point near Maumee. He escaped without a scratch.

THE contract for lighting the handsome Ford bridge at the Ford street crossing, Hartford, Conn., has been awarded to the City Gas Light Company, of Hartford, and General Harbison smiles at his competitors. The agreement is to last for three years.

MR. E. H. JENKINS, writing to us from Columbus, Ga., under date of the 5th inst., says: "We are having a big rush in our gas business here at the present time, and the prospects are favorable for a large increase in our output for the coming winter season as against that of last year. We placed a 16-horse power Otto gas engine last week, and have sold a large number of gas stoves."

MR. L. C. ATWOOD has been appointed General Superintendent of the Belleville (Ills.) Gas Light and Coke Company.

THE consumers of the Coney Island (N. Y.) Fuel Gas and Light Company are clamoring over the charges they have to pay for a gas supply—$1.75 per 1,000 cubic feet. They claim that since Gravesend township has become a part of the city of Brooklyn they should obtain their gas at the $1.25 rate. We believe the question is to be brought before the attention of the courts.

THE continued hearing on the petition of the Brookline (Mass.) Gas Company, before the Board of Gas and Electric Light Commissioners, for the right to increase its capital stock from $1,000,000 to $2,000,000, which was set for the 4th inst., was postponed on account of the illness of Commissioner Barker and the unavoidable absence of General Schaff. An adjournment was ordered, the hearing to be had at the call of the Chair.

THE new power house for the Bridgeport (Conn.) Traction Company, consisting of a dynamo room and a boiler room, will be of iron and brick—composite construction—designed by the Berlin Iron Bridge Company, of East Berlin, Conn. The dynamo room will be controlled by a traveling crane, to be furnished by the same parties.

MR. J. T. WESTCOTT, General Manager and Treasurer of the Economical Gas Apparatus Construction Company, of Toronto, Canada, accompanied by his wife, sailed for England, per the Germanic, on the 10th inst. The length of their visit will be determined by circumstances.

THE proprietors of the Petaluma (Cal.) Gas Company have made an investment recently which is sure to return them big dividends in the near future; the said investment representing certain sums expended in overhauling the main system.

THE Berlin Iron Bridge Company, of East Berlin, Conn., will furnish the iron roof trusses for the new city armory at Pawtucket, R. I.

AMONGST the "assets" of the Consumers' Gas Company, of Montreal, a certain agreement exists under which the promoters of the Company promised to supply gas to the city for public uses at a very low price. Some time ago, or shortly after the news of the purchase by the Montreal Company of the Consumers' Company became public property, the Board of Aldermen communicated with the Secretary of the Consumers' Company respecting its intention to take up the public lighting on and after May 1st, 1895, and received the following reply:

"CONSUMERS' GAS COMPANY,
Montreal, 1st October, 1894.

"L. O. DAVID, City Clerk—Dear Sir: We have your communication of 28th ult., and before receiving the same it was our intention to advise you that we had sold our equipment and works to the Montreal Gas Company. In making the arrangement we have tried to get them to assume our obligations, but found them unwilling to accede to our request. Contrary to our expectations, we find that, on account of the climatic influences, we have not allowed sufficiently for the loss by condensation and leakage. Moreover, the fact that there is $2,500,000 of capital invested by Montreal citizens in the Montreal Gas Company, rendered it impossible for us to command the necessary capital. We have to express our thanks to the City Council for the consideration shown to us, and beg to assure them had it been possible to command the necessary capital to supply gas otherwise than at a loss, at the price mentioned in our tender, we would have spared no efforts to do so.

"Yours obediently, A. PHILLIPS, Secy."

THE New York Board of Electrical Control claims that the Consolidated Gas Company, in connecting its different stations by means of wires carrying electric currents, such wires being strung through its street mains, has acted illegally. Further, the Board, it is said, will prosecute the Company, taking the necessary steps in connection with the District Attorney. The Consolidated Company takes the stand (and it would seem to have all the best of the position) that its use of its mains for the purpose specified is perfectly legal and proper, in that it employed wires so laid for signalling between its stations before the Board of Electrical Control had any existence. The Company, therefore, refuses to remove the wires until ordered to do so by the courts.

NOT long ago we noted the fact that it was proposed to establish a gas plant at Harriman, Tenn., to which mention we may add that the scheme is in the hands of Mr. Isham Benefiel, a resident of Harriman.

THE following is from the last annual report of the Directors of the Jamaica Plain (Mass.) Gas Light Company, the fiscal year of which ended June 30, 1894: "The amount of gas manufactured during the past year was 57,726,500 cubic feet, an increase over the preceding year of 9,097,600 cubic feet, or 15 per cent. The coke sold was 100,929 bushels, and 1,649 barrels of tar have been sold at good prices. The average

yield of gas per pound of coal and oil for the past six months has been 5.19, and the average amount of gas produced per bench, each 24 hours, has been 50,350 cubic feet. The average candle power of the gas has been 18.88 candles. The greatest output of gas was on December 24, when 252,000 cubic feet were distributed. The greatest output the previous year was 208,000 cubic feet. 11,652 feet of new street mains have been laid, in sizes from 3 to 16 inches, on 30 different streets; and 5,770 feet of mains that had become of insufficient capacity have been relaid with mains of greatly increased capacity. The number of new meters set was 517; deducting the number removed, the net gain is 172 meters. During the year 197 new meters were purchased. The price of gas during the past year has been $1.80 per 1,000 cubic feet, net, and $1.50 per 1,000 feet for fuel purposes. Although we have received 20 cents per 1,000 feet less for gas used for lighting purposes, and 50 cents per 1,000 feet less for gas used for fuel purposes, and 30 cents per 1,000 feet less for gas used for street lighting than we received the previous year, we have, by the increased demand for gas, and economies effected, been enabled to keep up our usual earnings. Our street lamp contract continues until 1897, the contract price being $1.50 per 1,000 feet. In answer to the prevailing popular sentiment for a low price for gas we have deemed it judicious to make a reduction in the price for gas, and to that end have notified our consumers that on and after July 1 of the current year the net price will be $1.65 per 1,000 cubic feet. The increased use of gas, resulting from a lower price, and the regular addition of new takers, together with the increased economies which will be effected during the coming year will secure to the Company the usual earnings. The expenditures for repairs during the coming year will be very moderate, no extraordinary renewals or improvements being necessary. The usual extension of street mains will be necessary, but not nearly to the extent of last year; and their construction will be at a less cost than last year, due to the prevailing low price for pipe. The outlook for the continued prosperity of the Company is of the brightest character. Our field for business occupies a territory 7 miles long and 3 wide, which is constantly and rapidly increasing in population and buildings of the best character. Our capitalization is moderate, and all paid in, and represents the value of our property but by one-half. The Company has always been conservatively managed and has never augmented its capitalization by extravagant expenditures, experiments or patent rights. Its affairs are now economically managed, and its salary account is of the most modest proportions, and with a continued pursuance of the present policy its future prosperity is assured."

WM. BODY, of 513 Logan street, Toledo, Ohio, was recently accused by Manager Faben, of the Toledo Gas Light and Coke Company, of bye-passing the meter on his premises and obtaining a supply of gas without paying therefor. The discovery was made by Detective Nichter.

IN our issue for October 1st we reported that the proprietors of the Muncie (Ind.) Natural Gas Company had determined to make a substantial increase in the selling rates, which move caused a good deal of grumbling on the part of the consumers. The City Council, too, thought that the Company was exceeding its rights under its franchise, and, after a rambling discussion, the City Attorney (Mr. Warner), was instructed to examine and report upon the rights of the Company and the consumers in the premises. His findings are as follows: "At the last meeting of this Council the City Attorney was requested to render an opinion construing certain parts of the ordinance granting the Muncie Natural Gas Company the right to lay and construct a system of mains and pipes, etc., in the streets, alleys, public grounds, etc., of the city of Muncie. In compliance with this request I have carefully examined said ordinance, and especially Section 12 thereof, which is the section governing the attention of this Council by petition numerously signed by consumers of the said Company. Said section reads as follows: 'Said Company shall, so long as the supply of natural gas shall, in the opinion of its Board of Directors, be sufficient in quantity and quality for all purposes of the city and its inhabitants, furnish such gas to the inhabitants of said city residing or doing business along the lines of its mains and pipes, or reasonably near to the same, at all times when the same may be required, in such quantities as shall be deemed prudent; that in no case shall the total cost to such consumers, for private purposes, of such gas at any time exceed three-fourths of the current price of wood or coal for fuel or of artificial gas for lighting. That the price of natural gas to private consumers for heating purposes shall be regulated by a schedule of prices submitted by the Board of Directors to the Common Council of said city, at the beginning of each fiscal year, and that said Company shall not, in any manner or for any purpose whatever, exceed the prices so submitted for that year; which schedule shall not exceed the price above stated in this section, said present price of wood being $2.50 per cord; of anthracite coal, $6 per ton; of soft coal, $4 per ton; and of artificial gas, $1.30 per 1,000 cubic feet. Under this section the price is regulated by a schedule of prices submitted by the Board of Directors to the Common Council of said city at the beginning of said fiscal year, and said Company shall not in any manner for any purpose exceed the price for that year. Neither shall said schedule exceed the price named in this section.' Therefore, it is clear to my mind that the submission of said schedule to this Council answers a double purpose. First, to fix the price which cannot be exceeded during the following year; second, to acquaint the givers of the franchise with the price so fixed, that they may determine whether or not the same was within the limits fixed by said franchise. The Muncie Natural Gas Company is bound by the prices fixed in section 12 of this ordinance; whether the said rate by the present schedule has been exceeded is a question of fact not for me to determine."

WHEN the report had been read, on motion of Mr. Zook a committee was appointed to determine whether or not the Company's schedule was within the rate limit provided for in the ordinance.

AT a recent meeting of the Committee on Gas, Philadelphia City Councils, the ordinance submitted by Mr. Meehan, providing for the creation of a loan for the purchase of the 25th Ward water gas plant, was referred to the Committee on Works and Estimates.

AT a meeting of the Board of Commissioners of Red Bank, N. J., a party named Hope submitted the following offers for the public lighting. It is understood that Hope represented Messrs. G. W. Harris and H. A. Jones, who in turn are supposed to be the backers of the New York Gas Improvement Company: Electric lighting proposals: For 1,200-candle power arcs (not less than 35), every night and all night table, $88 per lamp per year. For 1,200-candle power arcs, 25 nights per month, to 4 A.M. in winter, to 3 A.M. in summer (and not less than 120 incandescent lamps), $70 each—or $4,250 per year for all the lights. For 120 32-candle power lamps, every night and all night, $24 per lamp per year. For 120 32-candle power lamps, 25 nights per month, $20 per lamp per year. For 300 32-candle power lamps, for 25 nights, to 3 A.M., $18 per lamp per year—same rate for 120 more, if 35 arc lights are used. For 300 20-candle power lamps, for 25 nights to 3 A.M., 6 months, and to 4 A.M., six months, $15 per lamp per year. This offer is for not less than 250 incandescent lamps, if no arc lights are used, to include the main body of the town, and also any other part of the town required to be lighted for a term of not less than 5 years. The town to provide all rights to use of streets, etc., for electric lighting and to take all the street lighting for the term from this party, their successors or assigns. If a 10-year contract is made, 5 per cent. off of each price. If the Commissioners want thirty-five 1,200-candle power lights and 120 thirty-two candle power incandescent lights, they will cost the town $5,960 per year for 5 years, or 5 per cent. less if a 10-year contract is made.

THE proposal for gas lighting was as follows: We would offer to furnish lamp posts and lamps and the necessary gas, and extinguish the lights and keep the lamps in repair, as follows: For a 20-candle gas light, to be lighted all night and every night, $17.50 per lamp per year. For a 20-candle gas light, to be lighted every night, to 3 o'clock A.M., six months, and 4 o'clock A.M., six months, $15 per lamp per year. (This light is more diffusive than the electric light, and will light the streets equal to a 32-candle electric light.) This offer is for not less than 250 lamps, to include the main body of the town, and also any other part of the town required to be lighted, for a term of not less than 5 years. The town to provide all rights to use streets, etc., for gas lighting, and to take all street lighting for the town from this party, their successors or assigns. If a 10-year contract is made, 5 per cent. off of each price.

THE Commissioners laid the offers on the table, where they ought to be allowed to remain.

THE Providence (R. I.) Gas Company has had its attention called to the fact that sneak thieves have been masquerading as meter takers amongst the consumers. The light-fingered gentry have met with some success in their pilferings, which is solely the fault of the plundered ones, for everyone in the employ of the Providence Gas Company, whose duties require him to enter the houses of the Company's patrons, is furnished with a distinctive badge, that he is obliged to show whenever a demand is made upon him for its presentation.

SEALED bids for the public lighting of Grand Rapids, Mich., will be received by the City Clerk up to 5 P.M. of the 27th inst.

THE news has been widely published that Mr. J. E. Addicks has retired from active connection with the gas interests of Boston, Mass. In the meantime, however, it would be just as well not to put too much faith in the literal construction of the announcement.

THE New Utrecht (L. I.) Citizens' League is back of the case, entitled Walter E. Parfitt vs. Cornelius Ferguson, *et al.*, in which complainant seeks to invalidate the contract under which the Kings County Gas and Illuminating Company is performing the public lighting of the town, the agreement having several years to run.

THE heirloom of a public lighting contract which came to the Westerly (R. I.) Gas Company when it took over the local electric lighting enterprise, is about at its end as a legacy. Under it the contractors had to maintain arc lamps (moon table) on the basis of an annual payment of $59 each, and 16-candle power incandescents for $11.80 each, but the Westerly Gas and Electric Light Company, in the making of a new contract, asks $75 and $15 respectively.

THE Sioux City (Ia.) Gas Company is completing a new feeding main, running from the holders through the center of its district.

THE City Council of Waco, Tex., has, through the action of its Gas Committee, awarded a contract for the public lighting by means of arc lamps to the Waco Gas Company. The contract calls for 2,000-candle power arcs, all night and every night, to be paid for at the rate of $11.50 each per month; and the agreement is to last for 10 years.

THE proprietors of Santa Fe (N. M.) Gas and Electric Company have authorized the General Electric Company to construct for them a 150-horse power electric plant. It is to be completed by January 1st.

E. M. MONTGOMERY, of Buffalo, N. Y., representing the Canisteo (N. Y.) Fuel Gas Company, has applied to the Common Council of Niagara Falls for a franchise to operate a gas works. The concern proposes to supply "fuel gas" at a rate not to exceed 25 cents per 1,000 cubic feet. It is not likely the promoters will succeed.

A QUEER news item is one that comes from Harrisburg, Pa., under date of 8th inst., which conveys the information that, in accordance with an ordinance, passed as a joke, tin shades have been placed on the electric light lamps facing the suburban districts of Harrisburg, in order to prevent any portion of the territory contiguous to the city limits from being illuminated. The ordinance is the result of the refusal of the inhabitants of the suburban districts to have their territory annexed to Harrisburg.

A NAPHTHA tank in leaky condition, on the plant of the Mount Holly (N. J.) Gas Company, is responsible for a fire that at one time threatened to work considerable damage, not only to the gas property, but to the belongings of the nearby mills of the Burlington Carpet Company. The damage at the end, however, was less than $400 in amount.

MR. FREDERICK W. MOUNT, Electrician to the St. John (N. B.) Gas Light Company, died suddenly on the morning of the 5th inst.

MR. CLARENCE D. TURNEY has been appointed receiver of the Consolidated Gas and Electric Light Company, of Westchester county, N. Y., which appointment was necessitated by the recent failure of Messrs. Coffin & Stanton, who were largely concerned in its financiering.

THE Chapman Valve Manufacturing Company is constructing an important addition to its excellent foundry plant, at Indian Orchard, Mass.

Dynamo Currents for Operating Fire Alarm Systems.

By MR. B. S. FLANDERS.

In considering the subject of a central office system of electric fire alarms we are accustomed to elaborate on the general construction and operation of the apparatus used, together with the methods employed to give out to the department an accurate alarm in the quickest possible time.

Comparisons between the systems of different cities have always been made on this basis; the two features of construction and arrangement of the various apparatus and methods of operating the same being the only factors considered, and but little if any thought has been given to the subject of batteries, without which the most elaborate and best conducted system would be useless.

While great progress has undoubtedly been made in general methods in all cities using a central office system, there have been up to a recent date no special improvements developed in the matter of supplying the actuating current since the first system was established in the city of Boston in 1852. And in view of the fact that Boston was the first city to try the experiment of utilizing this subtle agent in transmitting intelligence of fires to its department, it seems quite fitting that it should also be the pioneer in the new field now under consideration in this paper.

The question of employing the dynamo for operating the fire alarm system of Boston first presented itself to my mind early in the year 1891, when I commenced a careful study of the problem and instituted a series of thorough and exhaustive experiments with the view of ascertaining whether or not it would be practicable to adopt such a system in place of the modified form of gravity battery then in use.

I procured a motor generator of comparatively low voltage and applied it to one of the circuits, which, like all the others in the system, required a constant current. The first tests were conducted with great caution, a supplementary battery being held in readiness to be applied at a moment's notice should any failure in the experiment be developed, but from the first it proved to be substantially successful, the only difficulty experienced being a tendency on the part of the field magnet to heat by constant service, and I was obliged to make a trial of several machines with different windings before I obtained satisfactory results.

The apparatus finally adopted, which has been in constant use during the past year, is constructed in a very compact and convenient form, and has thus far been driven by the 110-volt current supplied by the Edison Electric Illuminating Company, the output from the generator being equal to about 100 volts, giving very nearly 1 ampere of current.

After a few weeks of trial of the single circuit connection, I placed a group of six circuits in multiple connection, each circuit being equipped with a rheostat for facilitating the matter of regulating the current to the amount required.

I purposely selected circuits whose battery requirements were as exacting as any others in the entire system, the average need of each being about 50 volts with $\frac{1}{10}$ of an ampere of current.

There had been an aggregate of 350 cells of the gravity type in use to supply these circuits with a sufficient amount of current for their service, and I found no difficulty whatever in obtaining from this generator all that was required, with an excess of current in reserve to supply for at least as many more if necessary.

The constancy and steadiness of the current thus obtained, together with the facility for instantaneously increasing or decreasing it to meet the varying conditions of the circuits, have thoroughly convinced me, after a trial extending through so many months, that the dynamo is greatly superior in all respects to any form of galvanic battery yet used in the fire alarm service.

It seems to me that anyone who has had experience with the use and care of the ordinary types of batteries, especially in a service as exacting as that of the fire alarm, should gladly welcome and adopt a system from which all the disagreeable features attending their use have been eliminated.

In place of the tons of blue vitriol and zincs which are required to be handled, the barrels of unsightly *debris* usually waiting to be taken away, the unartistic frescoing of the shelves and floor caused by the solution which inevitably becomes scattered about more or less during the process of renewing the various elements of the cells, and the exasperated battery man, whose lacerated hands are throbbing with pain caused by the poisoned liquid absorbed while at his work, making him a fit subject for some energetic missionary endeavor, if we may judge anything by his remarks, we shall have a clean and pleasant apartment in which a set of beautiful machines will be symmetrically arranged, making the battery room not by any means the least interesting feature of the new fire alarm plant soon to be established in the city of Boston.

The results of my experiments thus far have fully convinced me that this new system is entirely practicable, and in all ways is so far superior to any other previously used that it has been definitely decided to adopt it, and all arrangements for the construction of the new office have been and are being made with that end in view.

A switchboard will be placed in connection for the purpose of utilizing the current of other companies for power to run the generators in addition to the local plant designed to be constructed for the new headquarters building, and the Edison Company now supplying, as it would be obviously unsafe to depend upon one source alone for this purpose.

I have also designed a multiple distributing board, and by its use any circuit or group of circuits can be connected with any generator at will at a moment's notice.

In conclusion, I have to say that the results of these experiments justify me in expressing the unqualified opinion that the adoption of this system will be one of the greatest improvements in fire alarm service considered in recent years.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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MONDAY, OCTOBER 15, 1894.

The Market for Gas Securities.

Dullness ruled the market for city shares last week, but there was no manifestation of weakness. In fact, if anything, prices were a trifle better sustained, Consolidated having sold on the Exchange on Wednesday last at 121¼. There were no sales Thursday, but to-day (Friday) 121 is freely bid for it. Standard preferred is in demand, at previous quotations, ex-dividend of 1 per cent., which was paid on the 10th inst. The preferred looks to us to be a purchase at anything under 90. Equitable and Mutual are neglected, but quotations are firmly held. There is no change, seemingly, in the Brooklyn situation, where prices are about the same as last week. The abnormally high rate for Williamsburgh appears to be the result of an attempt on the part of certain capitalists to take up a good holding in it.

The feature in outside shares was the erratic dealing in Bay State, which sold early in the week up to 32, and is offered to-day at 25½. The understanding is that Mr. Addicks is to retire nominally from the active management of this property. Chicago gas is strong, the outsiders having at last become reconciled to the belief that the Universal charter is in no sense a menace to the present gas interests of the city. Chicago sold to-day at 75. Baltimore Consolidated is offered at 68.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.

16 WALL ST., NEW YORK CITY.

OCTOBER 15.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	121	122
Central	500,000	50	103	—
" Scrip	220,000	—	100	—
Equitable	4,000,000	100	170	175
" Bonds	1,000,000	—	106	108
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	145	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	27	35
Preferred	5,000,000	100	79	82
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	112	116
Citizens	1,200,000	20	50	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	—	160
" Bonds	300,000		103	—
Peoples	1,000,000	10	75	—
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	145	—
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	170	—
" Ctfs.	700,000	1000	99	100
Williamsburgh	1,000,000	50	175	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	25¼	25½
Income Bonds	2,000,000	1000	44	45
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	80	83
2d " " "	3,000,000	1000	59	—
Buffalo Mutual, N. Y.	750,000	100	120	—
" Bonds	200,000	1000	95	100
Chicago Gas Company.	25,000,000	100	74¾	75
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	58	62½
Bonds	600,000	1000	92	—
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal.			90	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt.	11,000,000	100	—	68
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
Con. Bonds	.....	.....	—	50
East River Gas Co., Long Island City	1,000,000	100	20	22
Preferred	.....	.....	36	38
Bonds	500,000	100	81	82
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn.	750,000	25	120	128
Jersey City	750,000	20	190	200
Louisville, Ky.	2,570,000	50	125	130
Laclede Gas Light Co. St. Louis, Mo.—				
Common Stock	7,500,000	100	18	19
Preferred "	2,500,000	100	72	74
Bonds	9,034,400	1000	89	89½
Little Falls N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
New Haven, Conn.		25	200	—
Oakland, Cal.			42⅜	43
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Peoples, Jersey City	500,000	—	175	185
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	80	85
Preferred			90	95
Bonds			90	95
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co. San Francisco, Cal.	10,000,000	100	71	71½
Washington, D. C.	2,000,000	20	240	—
Wilmington, Del.	500,000	50	188	190

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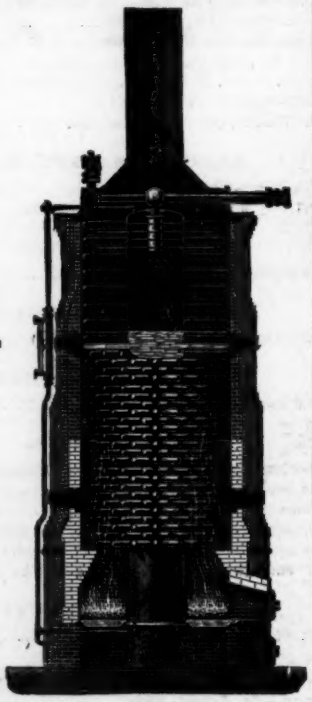

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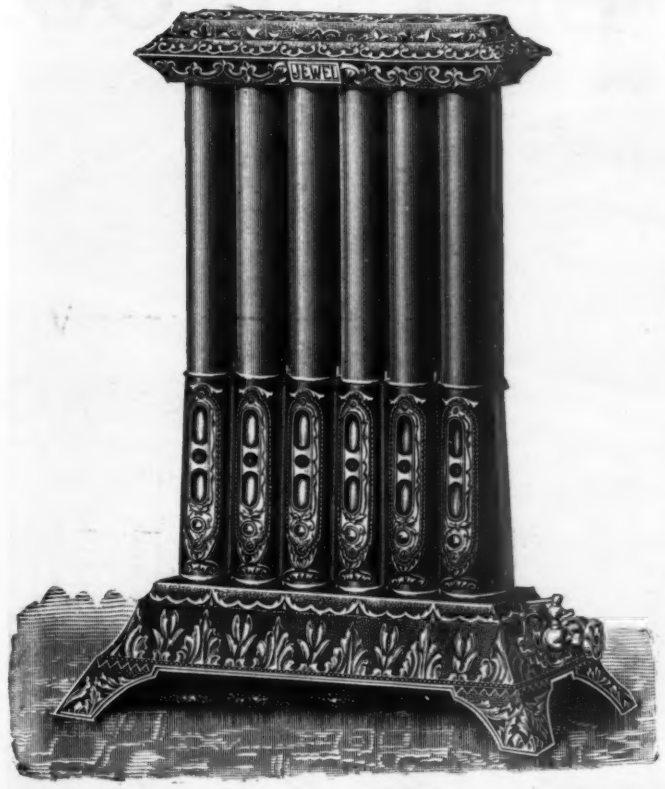

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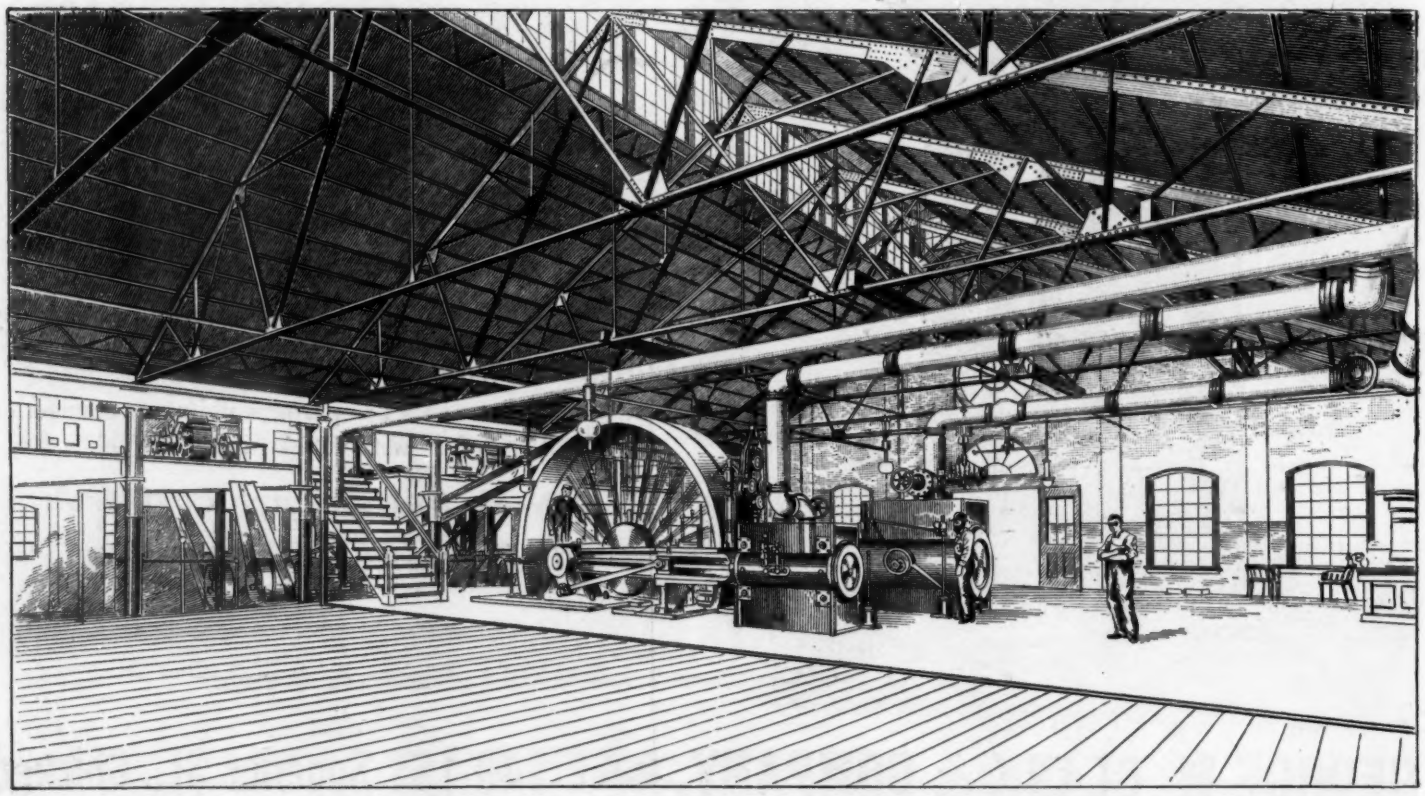

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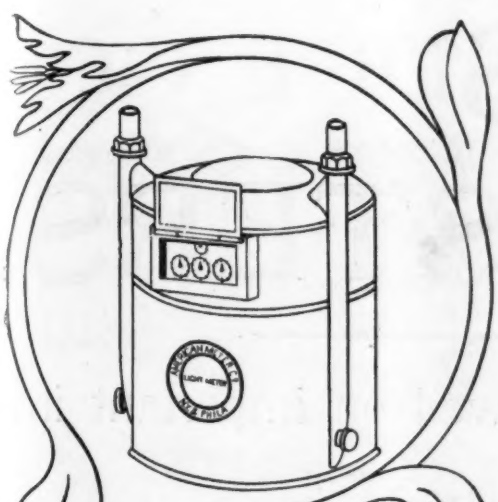

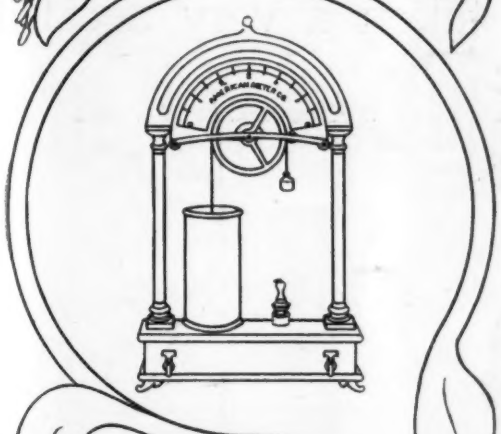

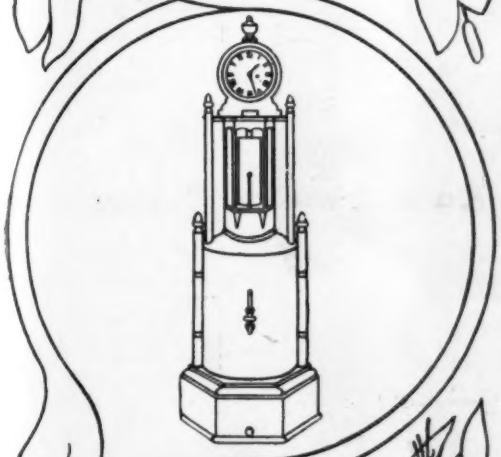

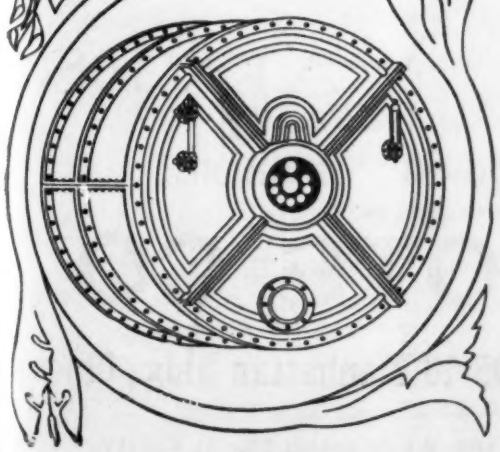

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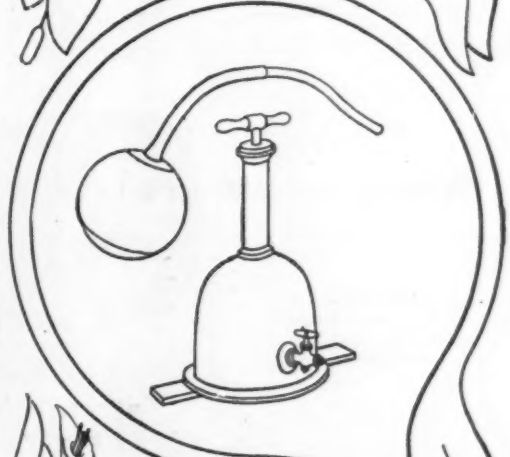
PUBLIC LIGHTING TABLE.

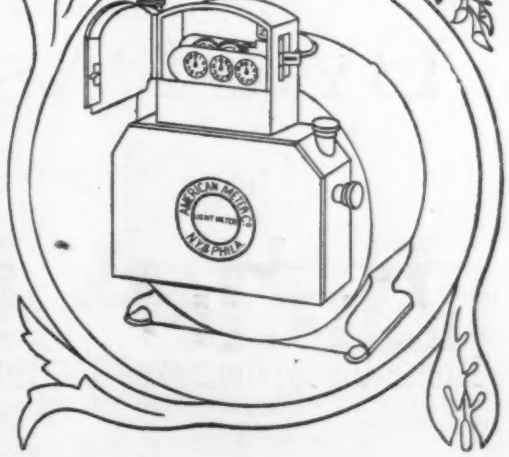
OCTOBER, 1894.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. Extinguish.
				P.M.	A.M.
Mon.	1	6.10 PM	5.00 AM	5.30	5.00
Tue.	2	6.10	5.00	5.30	5.00
Wed.	3	6.10	5.00	5.30	5.00
Thu.	4	7.40	5.00	5.30	5.00
Fri.	5	8.40	5.00	5.30	5.00
Sat.	6	9.30 FQ	5.00	5.30	5.00
Sun.	7	10.30	5.00	5.30	5.00
Mon.	8	11.40	5.00	5.20	5.10
Tue.	9	12.40 AM	5.00	5.20	5.10
Wed.	10	1.40	5.10	5.20	5.10
Thu.	11	2.50	5.10	5.20	5.10
Fri.	12	3.50	5.10	5.20	5.10
Sat.	13	No L.	No L.	5.20	5.10
Sun.	14	No L. FM	No L.	5.20	5.10
Mon.	15	No L.	No L.	5.10	5.20
Tue.	16	5.50 PM	7.10 PM	5.10	5.20
Wed.	17	5.50	7.50	5.10	5.20
Thu.	18	5.50	8.40	5.10	5.20
Fri.	19	5.40	9.40	5.10	5.20
Sat.	20	5.40	10.40	5.10	5.20
Sun.	21	5.40 LQ	12.00	5.10	5.20
Mon.	22	5.40	1.20 AM	5.00	5.30
Tue.	23	5.40	2.30	5.00	5.30
Wed.	24	5.40	3.40	5.00	5.30
Thu.	25	5.40	5.20	5.00	5.30
Fri.	26	5.30	5.20	5.00	5.30
Sat.	27	5.30	5.20	5.00	5.30
Sun.	28	5.30 NM	5.30	5.00	5.30
Mon.	29	5.30	5.30	4.45	5.35
Tue.	30	5.30	5.30	4.45	5.35
Wed.	31	5.30	5.30	4.45	5.35

TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Total	2274.20	Total	3987.45





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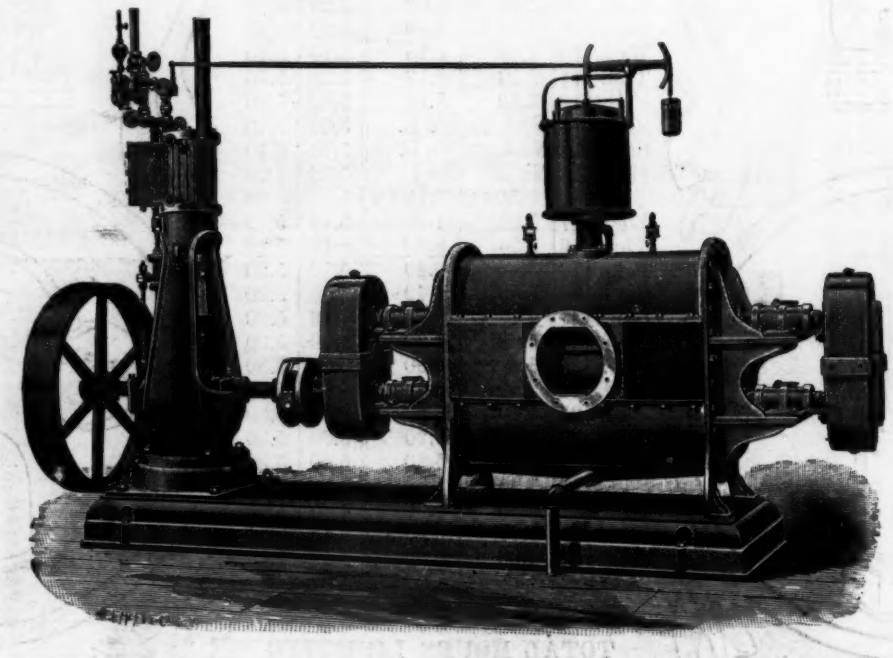

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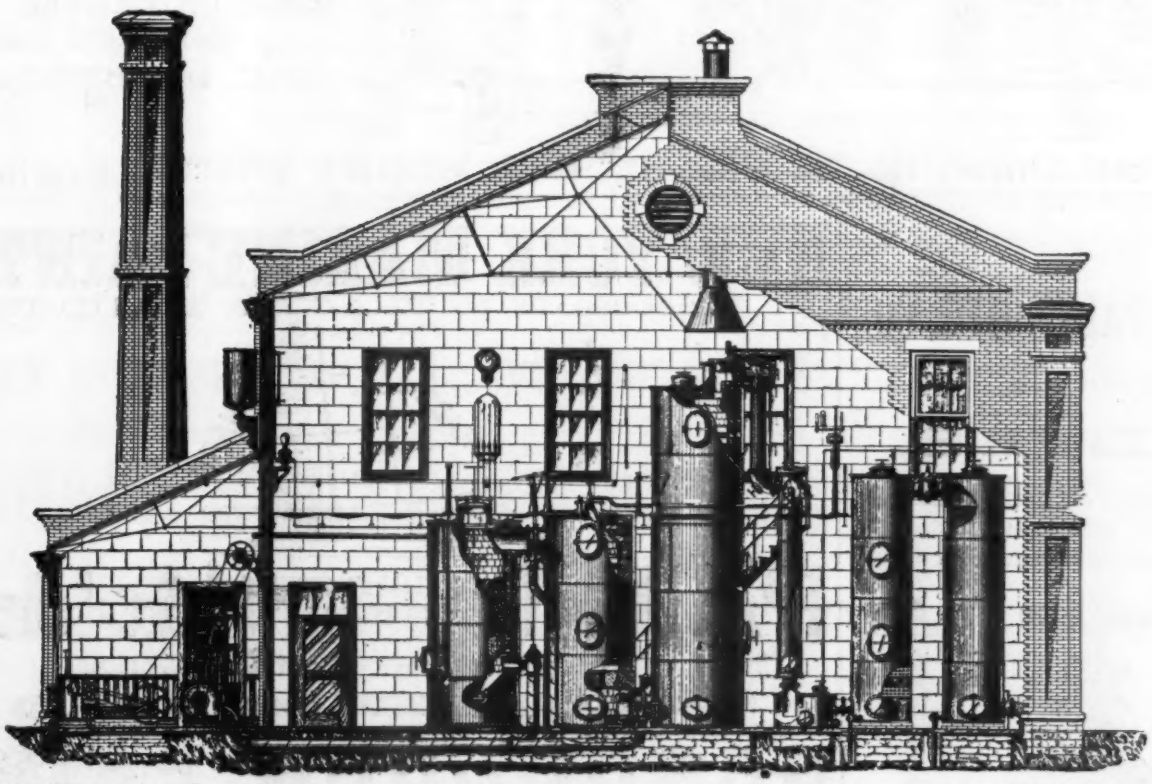

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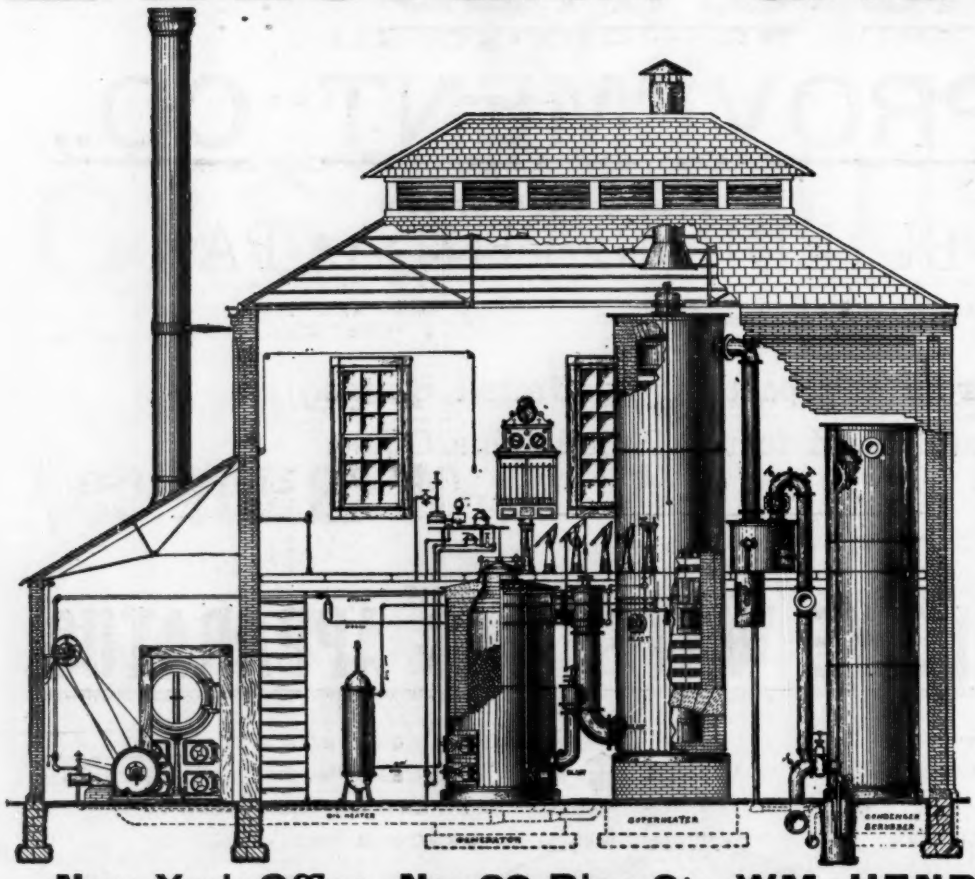

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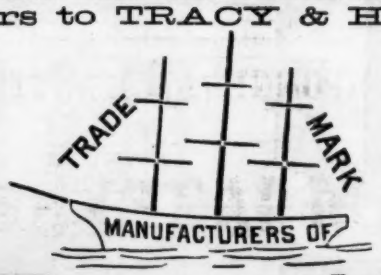

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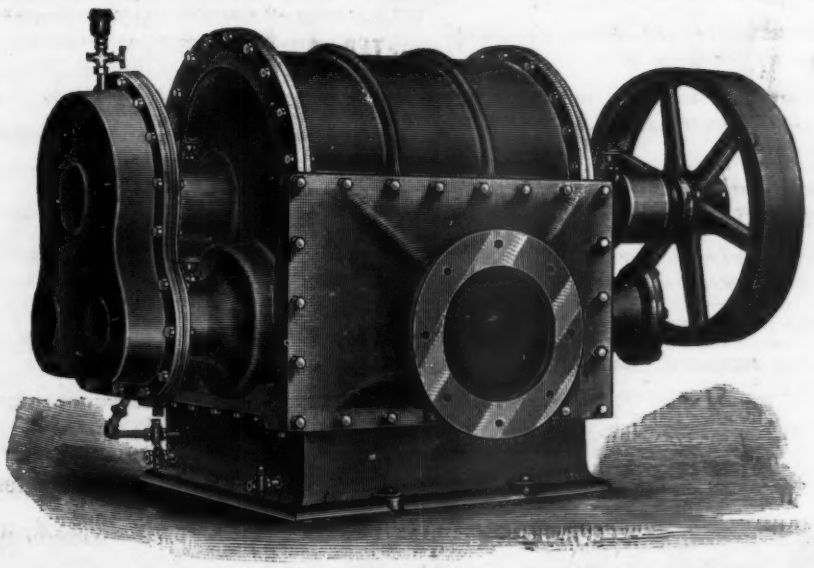

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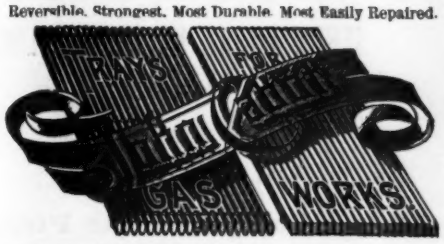

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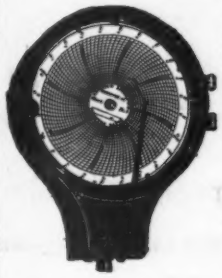

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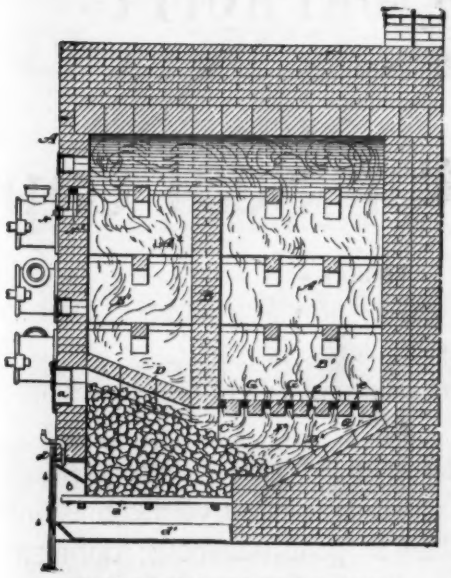

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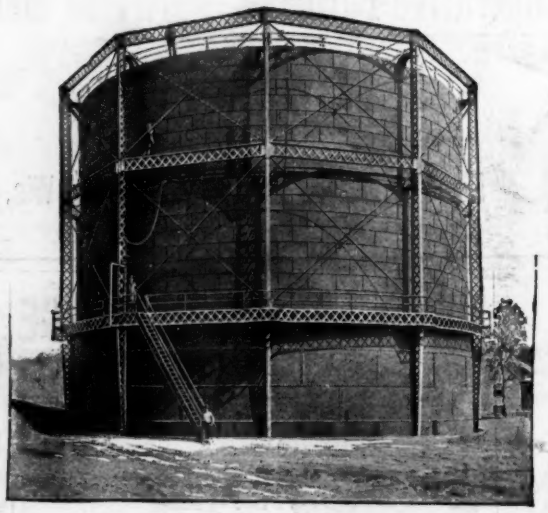

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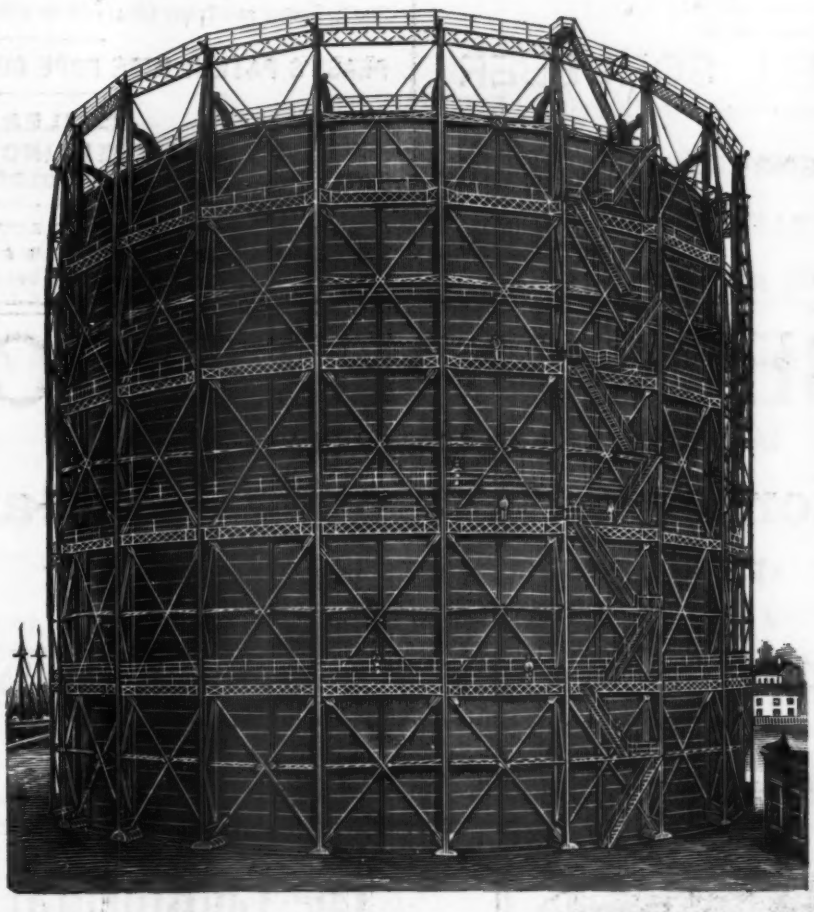

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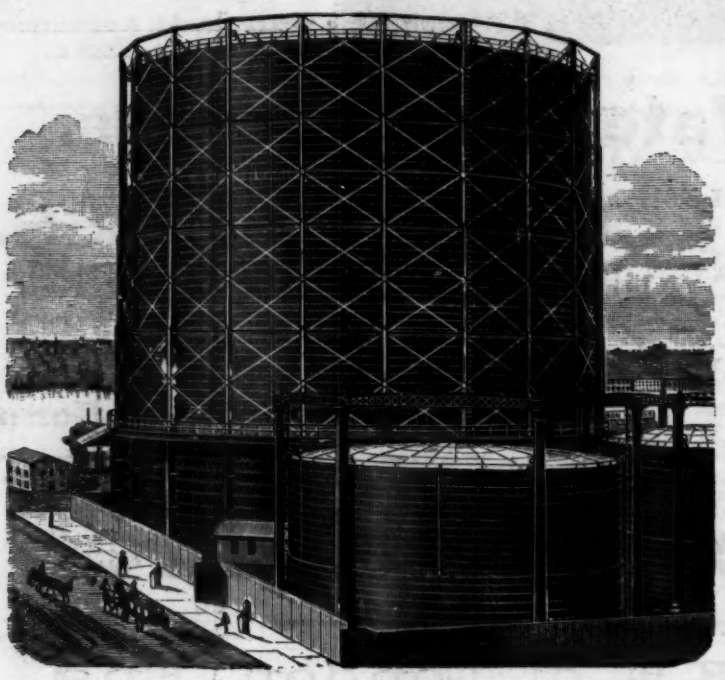

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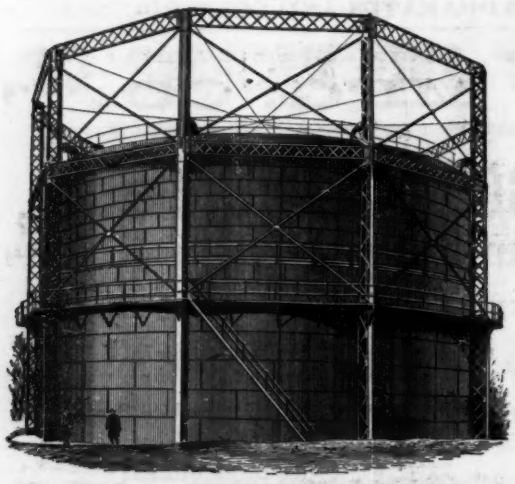

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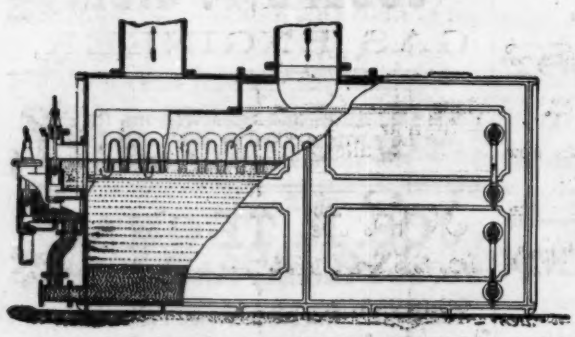

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More than **300** in Use.

REMOVES ALL THE TAR AND A LARGE PART OF THE CARBONIC ACID.

Ask the Brooklyn Gas Company, the Bridgeport Gas Co., the Brookline Gas Co., the Nassau Gas Co., the Providence Gas Co., the Trenton Gas Co., and a number of others which we can't name for want of space, if IT won't.

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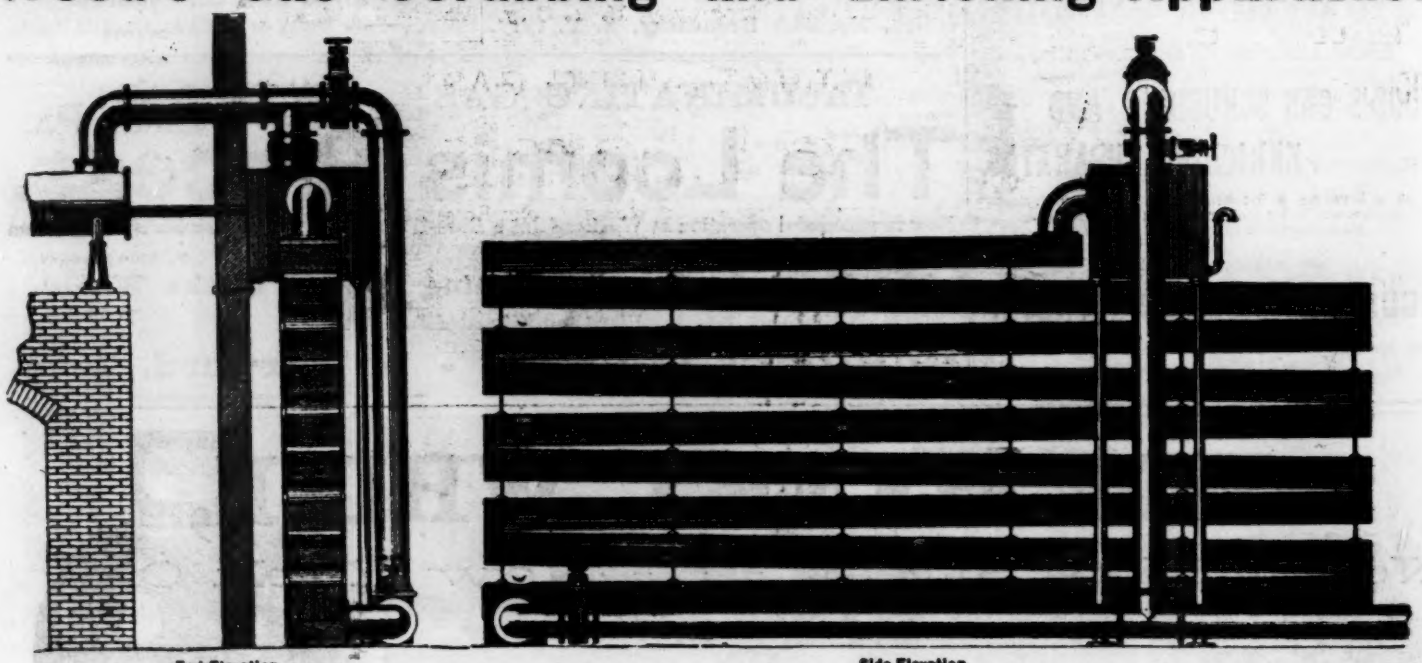
Wood's Gas Scrubbing and Enriching Apparatus.



End Elevation. Side Elevation.

The cheapest, simplest, and most effective apparatus for removing Tar and Ammonia, and enriching Gas, ever brought to the attention of Gas Manufacturers. With ordinary condensers and scrubbers the condensable illuminants flow off to the tar wells and liquor tanks and are lost, but with Wood's Apparatus these illuminants are saved and retained in the gas, thus increasing its illuminating power and making a great saving in the cost of enriching material. Where set up next after the Hydraulic main, this Scrubber produces an 8-oz. Ammoniacal Liquor.

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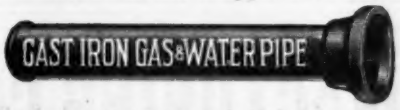

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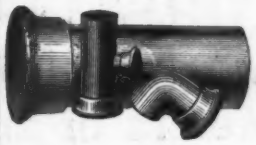

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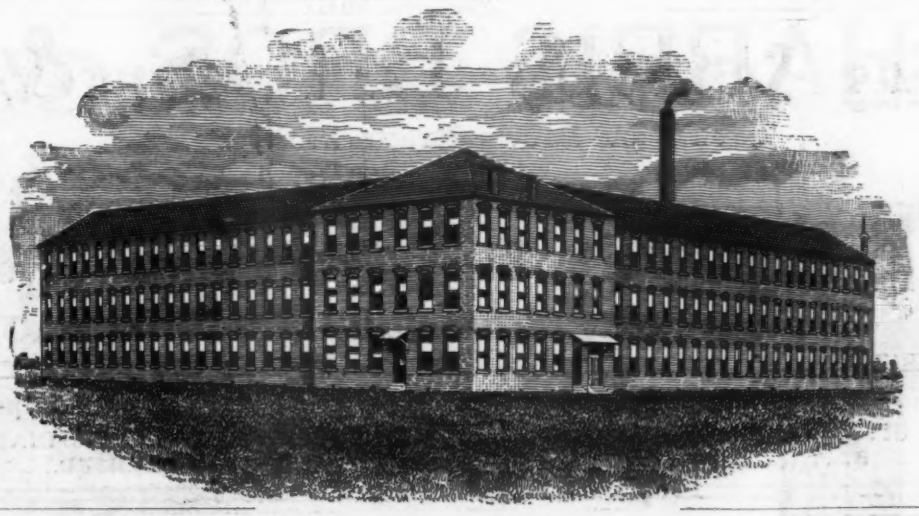

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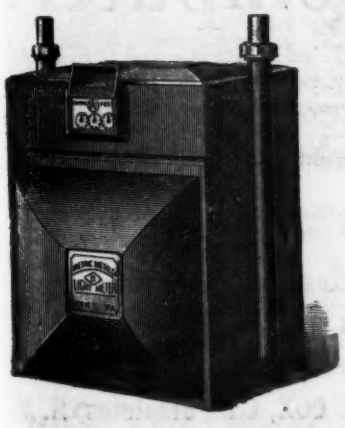

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Test and Experimental Meters, Pressure Registers, Pressure Gauges.

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CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Success" and "Perfect" Gas Stoves.

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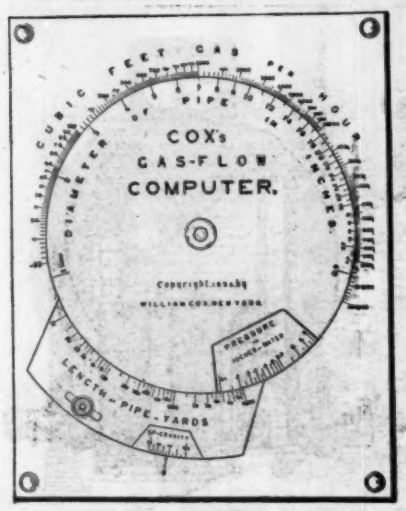

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1. It gives at a glance the discharge of gas from pipes 1 to 48 inches in diameter and 10 to 10,000 yds. long, for any pressure from 0.1 to 4.0 inches of water, and any specific gravity from 0.40 to 1.00.

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3. When the required discharge and the length of pipe are given, the pressure corresponding to any diameter is at once found.

4. Any suitable combination of the different factors of any problem, under all possible conditions, may be immediately found.

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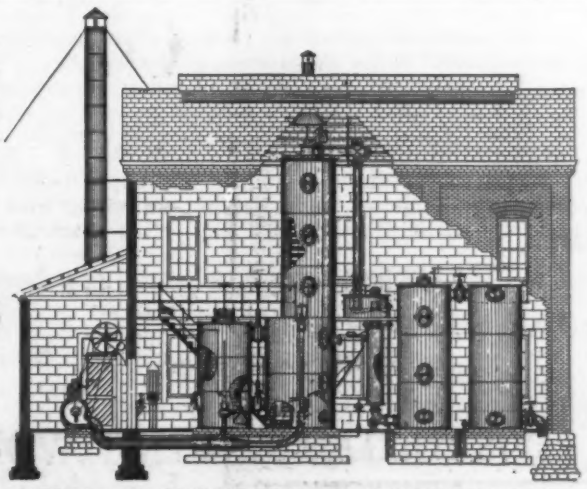

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For smooth and quiet running.
For simplicity of construction and grace in design.
For general reliability.
For close regulation of power.

150 MEDALS AND DIPLOMAS.

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The First to use the four-stroke cycle. **The First** to admit well measured and distinct charges of gas into an air space. **The First** in the adoption of poppet valves. **The First** to develop the tube igniter, with automatic or timed firing. **The First** to have a reliable electric and a practical magnectic igniter.

THE FIRST SMOOTH RUNNING & NOISELESS GAS ENGINE COMBINING EFFICIENCY & SIMPLICITY.

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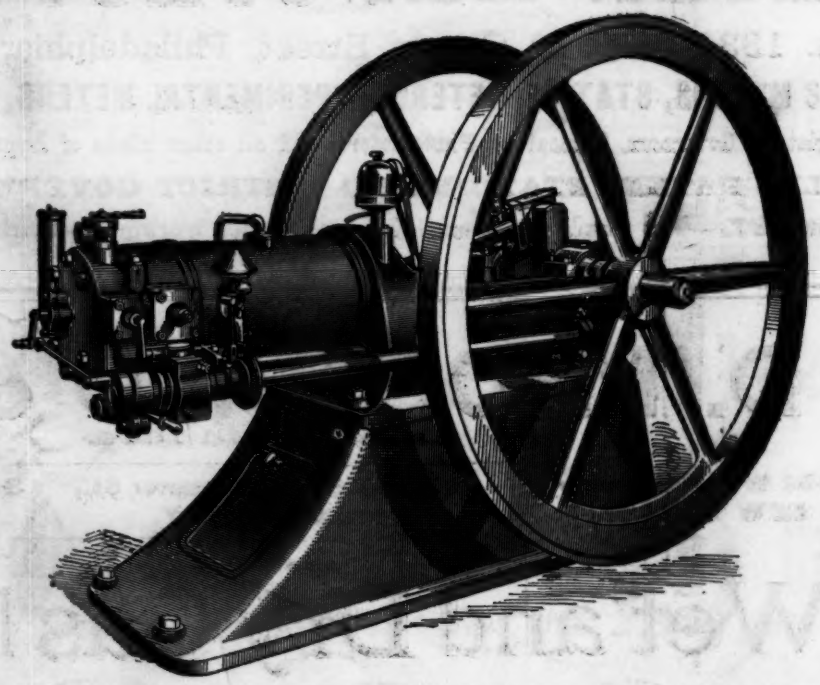
With removable seats and casings for all valves.

With Patent Alloy Tube, good for one year.

With timing device for ignition, preventing starting backward; or with electric igniter.



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Sizes,
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